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ABSTRACT

This guide is intended to aid teachers in the instruction of radio and television repair by creating competencies that have been identified by the Electronics Service Industry and structuring them into progressive learning blocks. These competencies aid students on the job and also facilitate transferability of students between programs in different colleges and from high school to community college. The guide is meant to be used in any order and in any amount the teacher wishes. The guide contains building blocks for learning, objectives for functional analysis, competencies, vocational skills record, television-radio curriculum, suggested textbooks, sample texts, and lists of audiovisual aids. A task inventory for television service and repair and radio repair is included to be used by the teacher to record completion of competency requirements for various tasks by the students. (KC)

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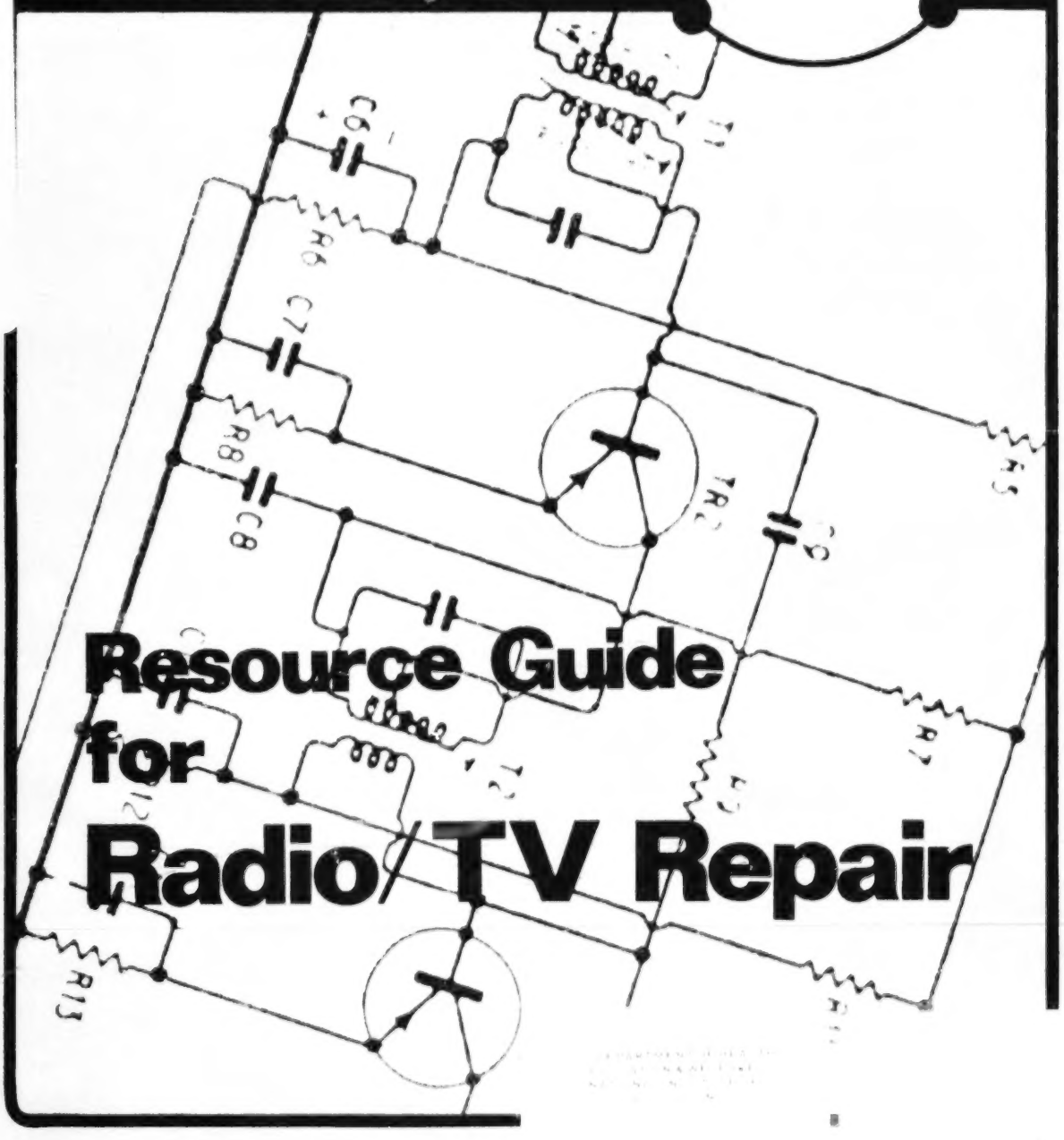
INDIVIDUALIZED LEARNING SYSTEMS



Resource Guide for Radio/TV Repair

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INDIVIDUALIZED LEARNING SYSTEMS

Resource Guide for Radio/TV Repair

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RESOURCE GUIDE FOR
RADIO/TV REPAIR

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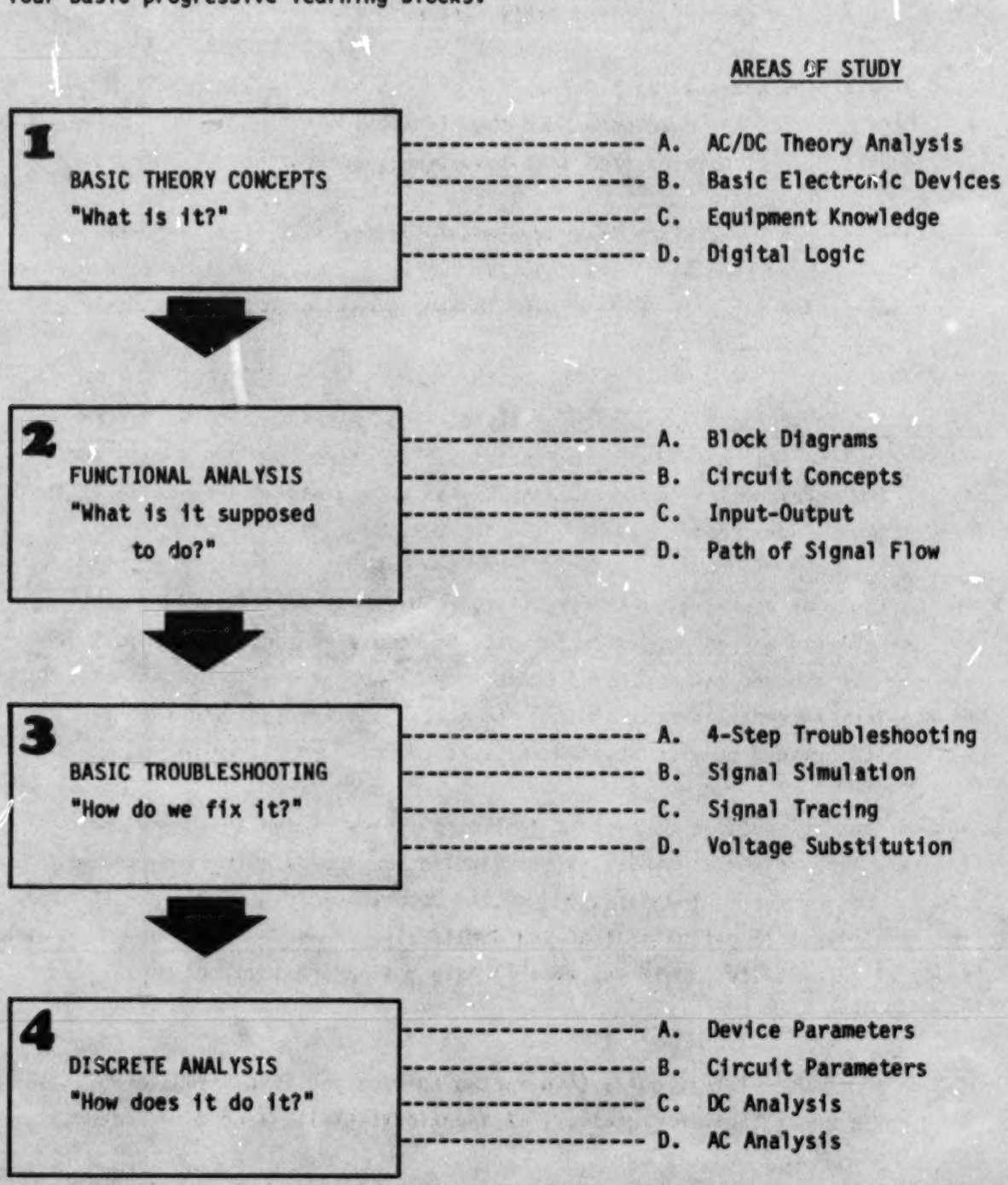
INTRODUCTION

All courses of study for a radio/TV repair course look similar; yet graduating students enter the field without the consistency in their abilities to do the job. They all may be well-trained in electronics, but without the proper emphasis as defined by service industry needs, the students do not know what is important, what to study, and what principles to apply in lab experiments. The hope of this guide is to provide you, the teacher, with the required competencies as defined by the Electronics Service Industry, and ways to implement them in your classroom. The scope of this manual was written as an idea book and no equipment or texts are specified. This will allow you the greatest flexibility in your teaching style and available lab facilities. References for materials are included at the end of this guide to provide a basis by which you may begin teaching in this area if you do not already include this area in your program.

Objectives, what the student should be able to do and competencies that they can do, have now been well-specified by industries. This should determine student outcome if we are to maintain creditability in this teaching profession. The scope of this guide is to present you with a summary of those competencies as told in instructional terms. We hope this will integrate easily into your classroom istruction and help provide industry with the type of technicians they need.

FOUR BUILDING BLOCKS FOR LEARNING

Each subject taught in radio and television servicing should be built around four basic progressive learning blocks.



To train a person to become a competent technician all four blocks must be utilized. High school career cluster programs may choose only basic competencies contained in each learning block catagory. Vocational high school or community college programs might utilize all competencies contained in each block. The chart specifies three major factors:

1. Progressive order of each block.
2. List of areas for development of competencies.
3. Level of difficulty of each area competency in order.

Student learning takes place at progressively different levels, beginning at the simple and working up to the complex. We must always retain that order in the selection of material to give all students a chance to build on their skills.

To support this progressive learning style, each learning block is broken down into areas and each area lists competencies that start from the simple and go toward the more complex concepts. The key to understanding this guide is to understand the progression.

In the study of any particular circuit there are many activities and tasks you can ask the student to do. When the student completes these successfully we can say the student has a certain competency. There are many competencies to choose from in each learning block. The number and level of the competency will be determined by your program and curriculum.

Notice that no specific circuit is mentioned in any of the following competencies. The reason is simply to standardize our approach in each area we study. If you choose the first and second competency from each learning block in the study of IF circuits, then you should also choose number 1 and 2 for the study of AF circuits. This way we will have a standard level of mastery in each area.

The intended use of this guide is directed to each individual subject of study in a radio and television receiver. A Vocational Skills Record included in

this guide lists all subject areas. You may check off each subject as the student satisfactorily completes the criteria outlined in the study guide.

For example:

SUBJECT

IF Circuits

AREAS:

Learning Block #2
FUNCTIONAL ANALYSIS

Block diagram of IF circuits.
Circuit concepts of IF circuits.
Input-Output of IF circuits.
Path of signal flow in IF circuits.

NAME	Block #1-2A	Block #1-3A	etc.

Learning Block #3
BASIC TROUBLESHOOTING

4-Step troubleshooting in IF circuits.
Signal simulation of IF signals.
Signal tracing in IF circuits.
Voltage substitution in IF circuits.

Below are suggestions for a progress chart.

Learning Block #4
DISCRETE ANALYSIS

Devise parameters in IF circuits.
Circuit parameters of IF circuits.
DC analysis of IF circuits.
AC analysis of IF circuits.

As was described earlier, the extent to which you will use competencies listed under each area will depend upon your curriculum. After the assigned competencies have been completed, proceed to the next subject area and repeat the process.

The reason for the index summary is to allow you to keep track of student progress. You may wish to construct a chart showing each student's name and a number listing of each competency. (See chart above.) In an individualized

learning system, paperwork can be a problem when you have many students working in different areas. I would suggest that you give the students a copy of the index summaries so they may keep track of their progress.

LEARNING BLOCK #1.
BASIC THEORY CONCEPTS "What is it?"

The study of radio and television repair inevitably begins with the study of basic theory. This allows the student to know "what is it" they are working with. Most materials teaching these competencies are in a standardized format and written in general terms so they are the easiest to apply within an individualized learning system. The available material, regardless of text or labs used can easily fit into this system. To avoid repetition of listing each specific competency, we have grouped them into a summary of desired lab outcomes.

The depth of study is the only real concern when applying these competencies to teaching radio and TV repair. While it is true that the deeper the understanding of basic theory, the better the technician, this is usually accomplished after more practical application.

The purpose of listing these competencies in the basic theory area is to give insight into the depth needed for this course of study. Only a few are listed in each area; however, several experiments may be needed to satisfy each competency.

The following is an index summary of the competencies by areas within the basic theory concepts learning block. This is followed by the listing of each individual competency outlined in the index.

LEARNING BLOCK #1. "What is it?"

BASIC THEORY

AREAS:

A. Resistance
B. Capacitance
C. Inductance
D. Resonance
E. Tubes
F. Transistors
G. Integrated Circuits
H. Others
I. Rectifier Circuits
J. Amplifiers
K. Oscillators
L. Switching
M. Equipment Knowledge

LEARNING BLOCK #1

SUMMARY OF OBJECTIVES FOR BASIC THEORY CONCEPTS

AREA A, RESISTANCE

1A Identify by using the color code and physical appearance, the wattage, resistance and type of resistor.

2A Apply Ohms and Watts Laws to a series parallel breadboard circuit, and using the proper meter, verify the calculated values.

3A Demonstrate the effects of Ohms Law by graphing the calculated values.

AREA B, CAPACITANCE

1B Identify capacitors by their value and type.

2B Apply the rules of series and parallel capacitors to a test circuit and using the proper meters verify calculated values.

3B Verify by experiment calculated values for R X C time constants.

AREA C, INDUCTANCE

1C Identify inductors by their value and types.

2C Apply the rules for inductors in series and parallel combinations, and verify by experiment the calculated values.

3C Verify by experiment calculated values for L X R time constants.

AREA D, RESONANCE

1D Apply the rules for series and parallel resonance to a test circuit and verify precalculated values.

2D Demonstrate the effects of resonant principles in band stop and band pass circuits.

3D Draw, by means of a graph, the frequency vs voltage characteristics of a series and parallel resonance circuit.

ELECTRONIC DEVICES

AREA E, TUBES

1E Identify from given schematics the types and number of tube used in a circuit. (i.e., 12AX7 dual triode, etc.)

2E Using a tube characteristic sheet, conduct a basic experiment to verify the data sheet information.

3E Specify the operating characteristics of each type of tube and draw a conclusion as to the major differences.

AREA F, TRANSITORS

1F Using an ohmmeter, identify the emitter, base and collector junctions.

2F Recognize the different transitor configurations from a set of given schematics.

3F State the rules for biasing a transitor, and using a basic circuit verify data published on a transistor spec sheet.

AREA G, INTEGRATED CIRCUITS

1G Using a data sheet, properly identify the terminal diagram.

2G Specify the use of each terminal on the IC.

3G Given an IC with schematic, construct the circuit to verify amplification and gain computations.

AREA H, OTHERS

1H Match the schematic symbol of each type of solid state device to its proper name.

2H State specific uses for each type of solid state device.

3H Using data sheets for specific devices, verify by experiment the given data.

BASIC ELECTRONIC CIRCUITS

AREA I, RECTIFIER CIRCUITS

1I Construct various types of rectifier circuits and evaluate computed values to measured values.

2I Evaluate by experiment the effects of various filter circuits and loads.

AREA J, AMPLIFIERS

1J From a given schematic, identify the different configurations and by experiment verify the characteristics of each configuration.

2J Verify by experiment the effects of different types of feedback to stablize operation.

AREA K, OSCILLATORS

1K From a given schematic, identify the type of oscillator circuit and by experiment verify the oscillator operation.

2K Verify by using a test circuit the proper test equipment the frequency of operation compared to calculated values.

AREA L, SWITCHING

1L Identify the type of switching circuit used. (i.e., monostable, bistable, etc.)

2L Verify by experiment the operation of given switching circuits.

AREA M, EQUIPMENT KNOWLEDGE

1M Testing: Given the appropriate test instruments, verify that the equipment is operating according to specifications.

2M Measuring: Given the appropriate test equipment and circuit under test, accurately evaluate readings obtained from the equipment.

3M Applications: Given various conditions to be evaluated, select the proper test instrument and properly hook it to the circuit under test.

4M Probes: Given various circuit voltages to be measured, select the correct probe for use and identify it by the proper trade name.

LEARNING BLOCK #2

FUNCTIONAL ANALYSIS "What is it Supposed to Do?"

There are two basic catagories of competencies, theory competencies and lab competencies. Theory competencies deal with textbooks, tests, and written criteria. Lab competencies are learned through experiments, or are learned by doing exercises. Generally theory is studied first to give the student a background of information on which to base a lab experiment. This guide will emphasize lab competencies in each of the major areas. Your course of study should encompass each of these competencies but not be limited to only those listed in this guide. As you begin to survey the circuit areas you will be covering, competencies based on a functional analysis should be presented next. This gives the student a good overview. Too much theory too quick will tend to confuse the student and hide the real issue of just what the circuit is supposed to do.

The following is an index summary of the competencies by areas within the Functional Analysis Block. this is followed by the listing of each individual competency outlined in the index. Before you begin to select competencies from the Functional Analysis Block, refer to the section of this guide which is titled "Teaching Principles for Functional Analysis." Outlined in this area is a general discussion of how you may apply some teaching techniques to satisfy the competency you select.

LEARNING BLOCK #2 "What is it Supposed to Do?"

SUMMARY OF OBJECTIVES FOR FUNCTIONAL ANALYSIS

Block Diagrams of Stages

The student should be able to:

1. show the basic concept of the section by illustrating a typical block diagram of all stages.
2. identify the specific part of the schematic that contains each stage.
3. explain the function of each stage.
4. describe what symptoms will appear in the receiver output with a failure in each stage.

Circuit Concepts of Stages

The student should be able to:

1. describe the basic circuit requirements for each stage.
2. describe the type of signal each stage will process.
3. explain what effects other stages in the receiver have upon the specific section of study.
4. describe the basic use or function of all parts in each stage.

Input Output of Stages

The student should be able to:

1. describe the type of signal that will flow into and out of each stage.
2. draw the input and output signal waveform pertaining to each stage by using a schematic or texts for reference.
3. describe the action of a stage which combines two individual signals at the input to produce one output signal.
4. describe the action of a stage which separates complex modulated signals at the input into individual frequency components at the output.

Path of Signal Flow in a Stage

The student should be able to:

1. trace the exact path that the signal will take through each stage on a schematic.
2. describe the main path of signal flow by identifying each component the signal passes through in each stage.
3. verify the path of signal flow through each component by using an oscilloscope.
4. examine the effects of each component on signal flow by noting signal voltage variations at the input and output of each component.

LEARNING BLOCK #2 "What is it Supposed to Do?"
FUNCTIONAL ANALYSIS

AREAS:
A. Block Diagrams
B. Circuit Concepts of Stage
C. Input-Output of Stage
D. Path of Signal Flow Within Stage

AREA A, BLOCK DIAGRAMS

1A Given a schematic of the circuit, draw a block diagram listing the device used for each block.

2A Given the circuit diagram, outline the block diagrams with a pen tracing over the schematic. Use arrows to show direction of signal travel.

3A Describe what each block in the block diagram is supposed to do.

4A Describe what symptoms will appear in the receiver output with a failure in each stage.

AREA B, CIRCUIT CONCEPTS OF A STAGE

1B Identify what type of signal each block stage is supposed to process with reference to frequency and type of carrier and modulation.

2B Identify the stage in terms of an amplifier, oscillator or rectifier and outline the circuit requirements for such a stage to operate.

3B Describe how various methods of feedback within the system effect the operation of the stage in question.

4B Make a list of all the components within the stage in question and identify the functional use of each part. (i.e., coupling cap, base bias resistor, etc.)

AREA C, INPUT-OUTPUT OF STAGE

1C Identify what type of signal flows into and out of each stage.

2C Examine, with the appropriate test equipment, the input and output signal voltages, noting frequency, voltage level and wave shape in a working receiver.

3C Describe the process of converting one signal frequency to another frequency within a particular stage.

4C Describe the process of removing the modulating information within a particular stage in the receiver.

AREA D, PATH OF SIGNAL FLOW WITHIN A STAGE

1D Given a schematic diagram, trace over the schematic with a colored pen the path that the signal will take from the beginning to the end of the circuit in question.

2D Write a flow analysis of each stage in the circuit diagram using schematic data. (i.e., The signal is coupled through C4 into the base of transistor Q2. The signal comes out of collector Q2 and is transformer coupled through T5 to the base of Q3, etc.)

3D Given a working receiver, trace the signal flow with an oscilloscope or AC meter through each component listed on the flow analysis above.

4D Construct a chart showing the various voltage levels at the input and output of each component listed in the flow analysis.

TEACHING PRINCIPLES FOR FUNCTIONAL ANALYSIS (Block #2)

AREAS:
A. Block Diagram
B. Circuit Concepts
C. Input-Output
D. Path of Signal Flow

AREA A, BLOCK DIAGRAMS

1A Obtain schematics of the circuit areas in question and have the student draw a complete set of block diagrams of the circuit on a separate sheet of paper. Each block should include the type of device used and the correct name of the stage. Be sure the student uses arrows on each block to indicate direction of signal travel.

2A If you can obtain multiple copies of the circuit diagram you are studying, have the student trace out the block diagrams right on the schematic. Have the students use colored pens for a clear distinct outline. this has proven to be an excellent tool for circuits that involve a complete system as it makes the student think in terms of relating one part of a circuit to another. Use REAL manufacturers schematic where possible, the real world of schematics are different from most textbook circuit diagrams.

3A After the student can identify the blocks, stage by stage, ask them to write an analysis of what the name means and specify what the block is supposed to do.

4A Using a block diagram of a complete system, have the student describe a basic symptom that you might expect to occur with a failure in each stage.

AREA B, CIRCUIT CONCEPTS

1B Ask the student to describe the exact type of signal each block stage is supposed to process. They should be able to identify the frequency and type of modulation used.

2B Have the student identify the stage in terms of an amplifier, oscillator or rectifier and explain basically what it takes to make the stage work properly. (i.e., proper bias voltages, feedback, signal coupling caps, etc.) This will begin to give the student an idea of the many possibilities of possible trouble spots.

3B Have the student examine the circuit diagram of a stage and pick out circuits that provide any kind of feedback which would effect its operation. (i.e., AGC, AVC, etc.) This will emphasize the effect one block stage may have on another.

4B Obtain a schematic of a circuit. List all the components on one side and mix up their functional names on the other side. Have them match up the proper trade name for each part.

AREA C, INPUT-OUTPUT

1C Have the student identify what type of signal goes into each block and what type of signal comes out. Have the student specify frequency, waveshape and type of modulation used.

2C If you have a working system from which the schematics were used, have the student draw the input and output signals. Have them indicate voltage, frequency and draw a picture of the waveshape. This exercise will give the student a basis by which to later troubleshoot a defective stage.

3C Have the student identify as many stages as possible where the input signal is not the same as the output signal and ask the student to explain the process used to convert the signal.

4C Have the student identify the detector stage in a receiver. Ask them to describe the process used to separate the remove modulation from the carrier.

AREA D, PATH OF SIGNAL FLOW

1D Once the student has correctly identified the proper direction of signal flow through each stage, give the student a schematic and ask them to trace out this path on the schematic using colored pens for clarity. Make sure they trace through the proper elements of a tube or transistor.

2D Ask the student to write a flow analysis for the part of the circuit under study. (i.e., The input signal is coupled through C2 into resonant circuit T1 and C4. The output is transformer coupled by secondary T1 into the base of transistor Q3, etc.) Every component that the signal goes through should be identified.

3D If you have a working system, have the student trace the signal through each component they covered in area 2D above. At this point it is only necessary that they can observe that

the signal comes in and goes out of each component. A more detailed analysis comes in Area 4D.

4D Ask the student to construct a chart labeling all the components in the order that the signal takes from the input to the output. They should show the signal voltage at each part, both at the input and output of each part. This will establish a pattern of voltage amplification and will show that at various points signals will appear to decrease instead of increase as they flow to toward the output. Ask the student to analyze any voltage discrepancies that appear in this process.

LEARNING BLOCK #3 BASIC TROUBLESHOOTING

"How Do We Fix It?"

The third selection of competencies should be for troubleshooting analysis. These competencies will tend to reinforce all the functional concepts by the practical application of the basic principles. "What is it? vs. What is it supposed to do?" This is translated into lab competencies which lets the student see if the circuit does what it is supposed to. This will allow the student to troubleshoot the instrument by two methods:

1. Testing to see what circuits are working normally.
2. Testing to see what circuits are not working normally.

Due to the complexity of many new circuits and the symptoms exhibited when they fail, these two principles allow the technician to trace out problems when the symptoms are not clear or identified by past experience.

The following is an index summary of the competencies by areas within the Basic Troubleshooting Learning Block. This is followed by the listing of each individual competency outlined in the index.

Before you begin to select competencies from the Basic Troubleshooting Block, refer to the section of this guide which is titled, "Teaching Principles for Basic Troubleshooting." Outlined in this area is a general discussion of how you may apply some teaching techniques to satisfy the competency you may select.

LEARNING BLOCK #3 "How Do We Fix It?"

SUMMARY OF OBJECTIVES FOR BASIC TROUBLESHOOTING

AREAS: 4-Step Procedure
Signal Simulation
Signal Tracing
Voltage Analysis

4-Step Procedure

The student should be able to:

1. describe how 4-step troubleshooting procedure is used to solve circuit problems.
2. explain the test equipment used in each step of the 4-step procedure.
3. describe the use of 4-step troubleshooting procedure in solving a circuit problem.
4. describe the orderly process of troubleshooting procedure by constructing a troubleshooting road map.

Signal Simulation

The student should be able to:

1. describe what type of signal generator can be used to substitute for a signal in each stage.
2. explain what effects should occur when using a signal generator at the input and output of each stage in a receiver.
3. examine the effects, stage by stage, by using a signal generator at the input and output of each stage and noting signal voltage variations.
4. prove by signal injection that each stage does amplify.

Signal Tracing

The student should be able to:

1. examine a transmitted or self-generated signal wave form at the input and output of each stage with an oscilloscope and compare the shape of each waveform to given schematic data.
2. examine a generator test signal at the input and output of each stage with an oscilloscope.
3. prove by signal tracing that each stage does amplify.
4. examine the use of a second receiver to trace a signal.

Voltage Analysis

The student should be able to:

1. explain what measurements indicate the stage is working correctly.
2. examine the effects of each transistor on controlling current by the use of the "cut-off test."
3. examine how suspected power supply problems can be eliminated by substituting an external power supply.
4. demonstrate how the bias of each stage can be substituted with an external power supply.

LEARNING BLOCK #3 "How Do We Fix It?"

BASIC TROUBLESHOOTING

AREAS:
- A. 4-Step Troubleshooting Procedure
- B. Signal Simulation
- C. Signal Tracing
- D. Voltage Substitution

AREA A, 4-STEP TROUBLESHOOTING PROCEDURE

1A Explain the 4-steps used in troubleshooting a defective receiver.

2A Identify the specific type of test equipment used in each step.

3A Given four possible symptoms on a type found within your circuit of study, list the four possibilities showing the process of 4-step troubleshooting procedure to solve each named symptom.

4A Construct a troubleshooting chart using block diagrams for each step in the 4-step procedure. The chart should act as a road map indicating the orderly process of finding a given circuit problem. (See example in information sheet.)

AREA B, SIGNAL SIMULATION/TECHNIQUES

1B Identify the exact type of signal needed at the output of the signal generator to substitute for each block in the circuit block diagram.

2B Set a signal generator to the correct output and insert the signal into each stage of a working receiver. Observe the audible or visual effects at the output of the system.

3B Hook a meter or scope to the output of a working receiver. Make a chart indicating the specific voltage measured as the generator is moved from stage to stage beginning at the meter or scope and working toward the antenna.

4B Construct a chart showing the approximate amplification factor of each stage obtained from competency #3 above.

AREA C, SIGNAL TRACING

1C Obtain a working radio or television receiver. With a normal signal at the input of the receiver, trace the signal through each stage using an oscilloscope or AC meter. Construct a chart showing the voltage levels stage by stage.

2C Set a signal generator to the input of a working radio or TV receiver. Trace the signal through each stage beginning at the generator and working toward the output stage. Construct a chart showing the voltage levels stage by stage.

3C Using a second working receiver, feed in a signal from the good receiver to the receiver under test to check for a defective stage.

4C Using your test receiver, feed a signal into a second working receiver to test for the presence of a signal from your test receiver.

AREA D, VOLTAGE ANALYSIS AND SUBSTITUTION TECHNIQUES

1D Describe what DC voltage measurements indicate the stage is working properly.

2D Test the control characteristics of each transistor by making a "cut-off test" on each device. Make a chart and show the voltage changes that occur on the emitter, base, and collector when the transistor is cut off and no current flows in the circuit.

3D Substitute the main supply voltage with an external power supply making sure the circuit performs normally using the external supply.

4D Clamp the base bias at each device to rated voltage levels and measure the collector and emitter terminal voltages to see that they confirm the listed schematic values.

TEACHING PRINCIPLES FOR BASIC TROUBLESHOOTING (Block #3)

AREAS:
A. 4-Step Troubleshooting procedure
B. Signal Simulation
C. Signal Tracing
D. Voltage Substitution

AREA A, 4-Step Troubleshooting Procedure

1A To fix a problem in any electronic device a logical order of troubleshooting needs to be followed to isolate the defective part as quickly as possible. One logical process is defined as 4-step troubleshooting procedure. the order is as follows: 1) Isolate the section, 2) Isolate the stage, 3) Isolate the circuit, 4) Isolate the component.

2A This order is very important to quickly repair a product. The order also specifies certain types of equipment to be used in succession. This will avoid letting the student grab the meter and start checking voltages or resistances before narrowing down the suspected circuit. The only exception to this rule is in testing for proper power supply operation, which may be done first.

The equipment used should match up to the logical order as follows:

Step #1 Isolate the section--Use Signal generator or tracer.
Step #2 Isolate the stage--Use Signal generator or tracer.

Step #3 Isolate the circuit--Use meter, voltage and resistance testing.

Step #4 Isolate the component--Use meter, testing for shorts or opens.

Notice that the meter is not brought into the servicing analysis until Step #3. With beginning students this is very important as they will have a tendency to start checking voltages and resistances in areas of the circuit not yet defined as the trouble spot. Since most schematic readings do not match actual measurements, they will think they have discovered a problem when it is just normal variances.

There are exceptions to any rule or procedure, but exceptions or short-cuts should be taught only after much practice with the four steps outlined.

3A To define the 4-step troubleshooting procedure, look at the following chart that would apply to a radio.

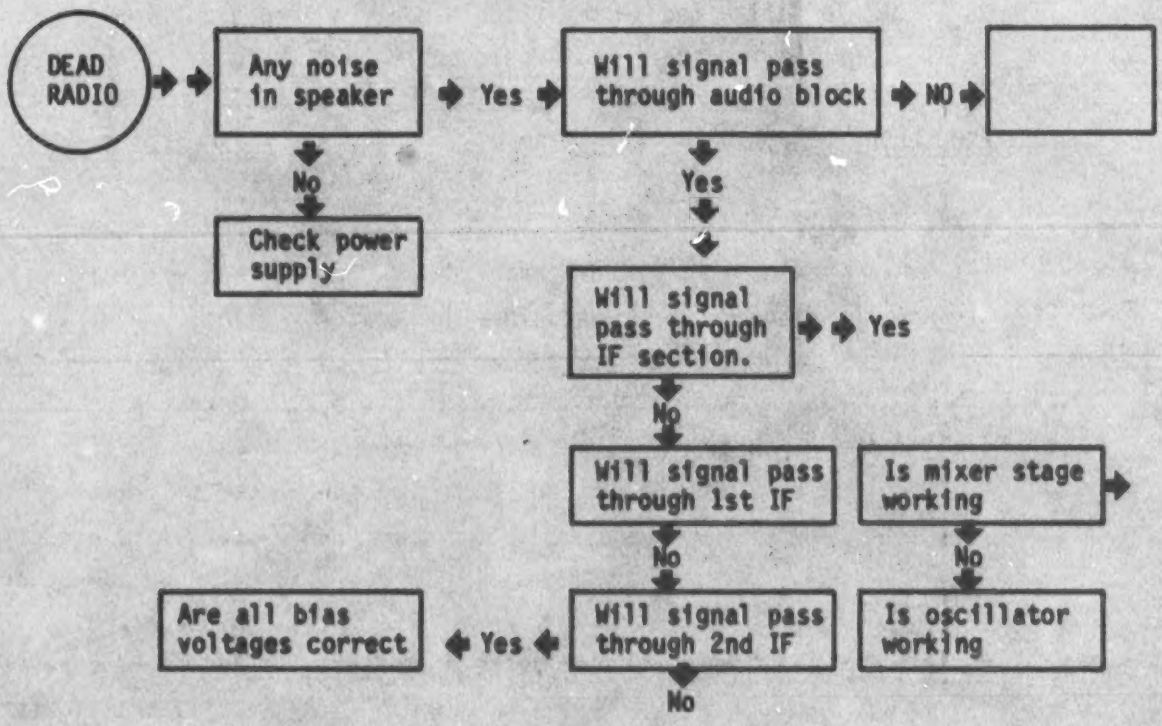
STEP	PROCEDURE	EQUIPMENT	ISOLATE TO:
#1	Isolate the section.	Use signal generator or tracer.	RF/IF, Audio Power supply.
#2	Isolate the stage	Use signal generator or tracer.	1st, 2nd, IFs Preamplifiers Output stage.
#3	Isolate the circuit.	Use meter or scope.	Base, emitter or collector circuits, grid, cathode screen or plate circuits.
#4	Isolate the component	Use meter or tester.	Resistor, capacitor coil, transformer, etc.

Have the student practice this procedure, writing down several examples: Such as:

Audio section	IF section
Output stage	2nd IF amplifier
Collector circuit	Base circuit
Output transformer	Base resistor

Audio section	IF section
Driver stage	2nd IF amplifier
Emitter circuit	Base circuit
Emitter resistor	Coupling transformer

4A Have the student practice constructing a troubleshooting flow chart. Have them relate it to one of the examples they used in item 3A on the last competency. Flow charts are currently in use with many manufacturers as a means of solving circuit problems.



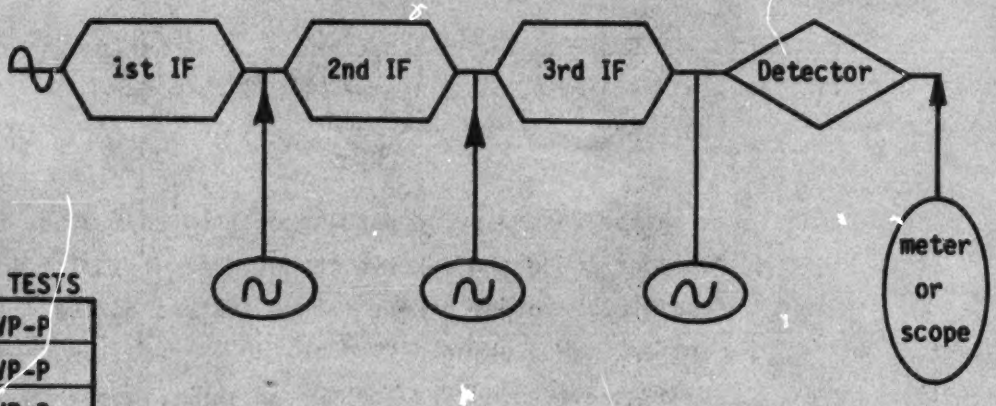
The importance of the chart is to have the students show each step they take to analyze a given symptom. This is a good written exercise for practicing troubleshooting procedure. Have the students do as many charts as you have time for.

AREA B, SIGNAL SIMULATION

1B Have the student identify the exact type of signal that would be used for substituting the signal voltage for each stage in a receiver. Have the student set up the signal generator to match what signals are present in each stage.

2B Have the student feed the signals into the appropriate section and observe the audible or visual results as they appear in the output.

3B Have the student insert the signals into each stage in each section of the receiver. The emphasis in this step is to let the student observe the signal being amplified by various stages within each section. Ask the student to place either a meter or a scope at the output of each section and record the signal level changes as the generator is moved through the varioud stages. Repeat this process in the audio section as well. See the example below for details:



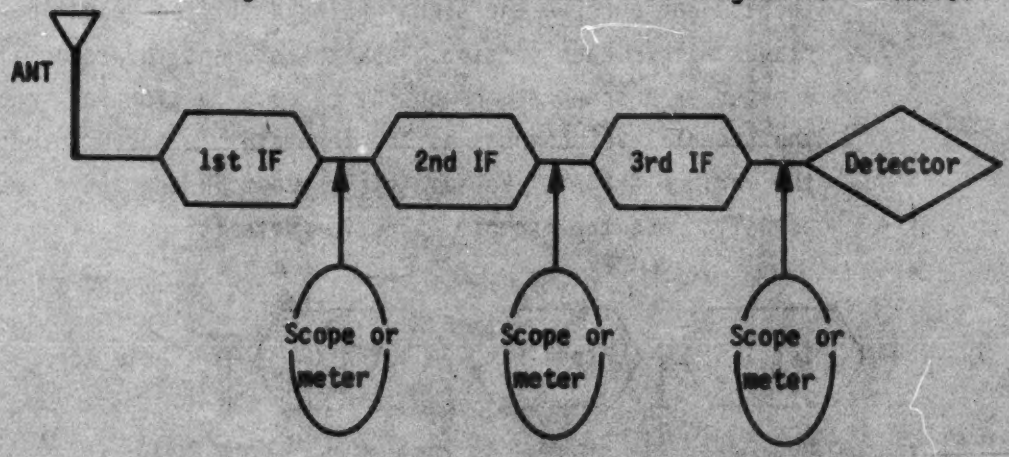
RESULTS OF TESTS	
1st IF	2VP-P
2nd IF	1VP-P
3rd IF	.3VP-P

4B Using the values measured in the chart for each stage in the receiver, have the student estimate the voltage gain of each stage. For example, if a voltage reading of 2 volts is indicated when the generator is at the input of the 1st IF and 1 volt when it is at the input of the 2nd IF, then the estimated voltage gain of the 1st IF stage would be 1 volt.

The student should be able to observe that each stage amplifies and that as the signal generator moves toward the last stage the output drops due to not as many amplifiers boosting up the signal.

AREA C, SIGNAL TRACING

1C Obtain a good working receiver. Have the student first learn signal tracing techniques using an "off the air signal" present at the antenna input. Have the student trace the results of the signal with a scope or AC meter through each stage and chart the results. See diagram for details.



It may be necessary, depending on the scope used, to use a detector probe and observe the effects of amplified modulation at the output of each stage instead of the composite carrier. When using a VTVM on the AC function, find out if it has the frequency response and input impedance needed to keep from loading down the signal. If not, use a RF EXTENDER PROBE which is good up to at least 200 MHz.

Using Off the Air Signal

1st IF out	.3V P-P
2nd IF out	1V P-P
3rd IF out	2V P-P

The object of this competency is to get the student to recognize that if you are tracing a signal it gets stronger as it is processed through each stage.

2C Using a working receiver, set up a signal generator to the antenna. Have the student trace the generator signal from input of the IF section to the output of the audio section. By using a generator signal instead of an off the air signal, you will be able to set the modulation level to a fixed value and therefore, apply this same technique to the audio section. If you try to do this with a live signal, the modulation levels will be changing constantly and no accurate reading will occur in the audio sections. The emphasis of this procedure is to get the student to realize how much easier it is to trace a generator signal than an off the air "live" signal. Be sure to have the student chart all the results.

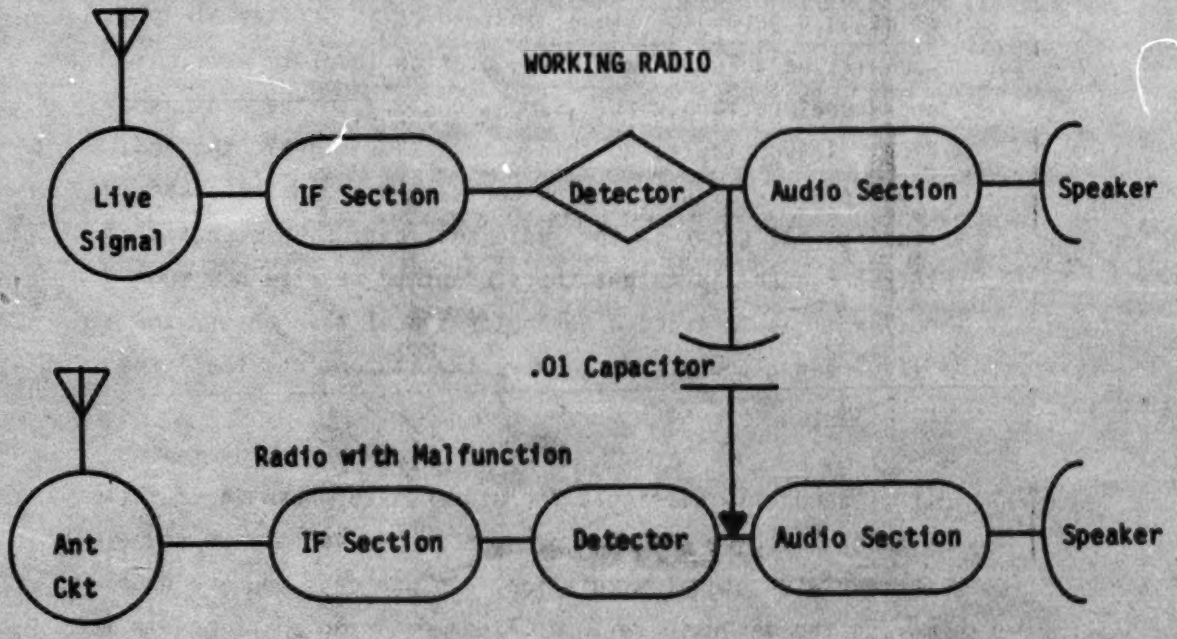
It is generally difficult for students to grasp whether the signal should be stronger or weaker when you mix up signal tracing with signal simulation. In one case you are usually moving the generator with a fixed measuring point and in the second case you have a constant input and are moving the measuring point. the student gets confused on deciding if the signal should be weaker or stronger. They need to be repeatedly tested on these procedures as it is the background for developing speed in diagnosis. There are three concepts that should be tested for:

1. The student must realize that if you put a signal at the input it will be amplified and appear stronger at the output on a stage by stage basis.

2. The student must realize that if you are tracing a signal coming into the input of the 1st stage it will get stronger as it goes toward the last stage.

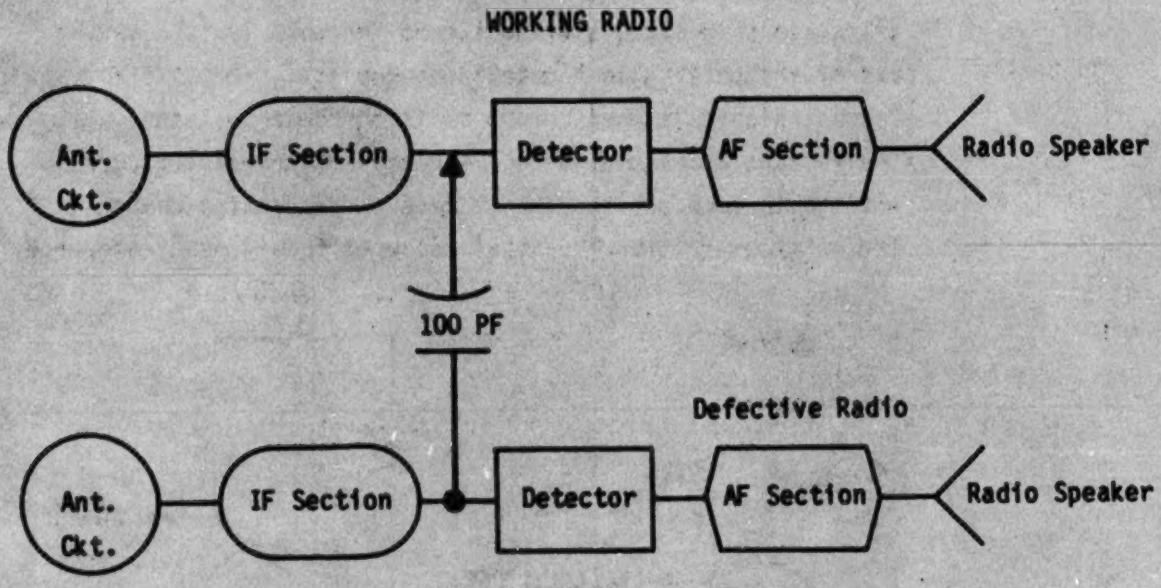
3. The student must realize that if you are moving the signal generator from stage to stage, the signal will get weaker as you work from the input toward the output.

3C Another type of signal tracing which can work effectively is using another radio to test for a working stage or section on a defective receiver. See the diagram below.



FOR SAFETY be sure to have an isolation transformer on your working radio if you use a set that plugs into the AC line. a battery operated transistor radio is recommended for these tests. For example: Tune the working radio to a radio station but leave the volume down. Run a .01 mfd capacitor through a clip lead from the output of the detector to the input of the audio amplifier on the set you are working on. If the audio section is OK, sound from the test radio will come through the audio amplifiers on the radio that has a malfunction.

4C Using an additional radio for testing a defective receiver gives the advantage of hearing a regular signal instead of listening to a tone from a generator. A similar but different approach to the competency listed in 3C is to have the student run a clip lead through a 100pf capacitor from the output of the last IF stage on the defective receiver to the input of detector on the working radio. If the IF stages in the bad receiver are functioning okay then you will hear the results coming out of the good radio. See the example illustration below.



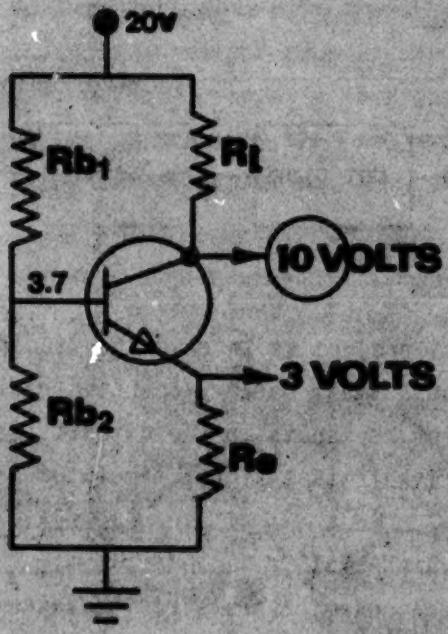
An excellent class project is to have the students make up a radio analyst from a small battery operated radio. By running a terminal board from key spots in the circuits, they will be able to use the radio itself as a signal simulator or signal tracer.

AREA D, VOLTAGE SUBSTITUTION AND ANALYSIS

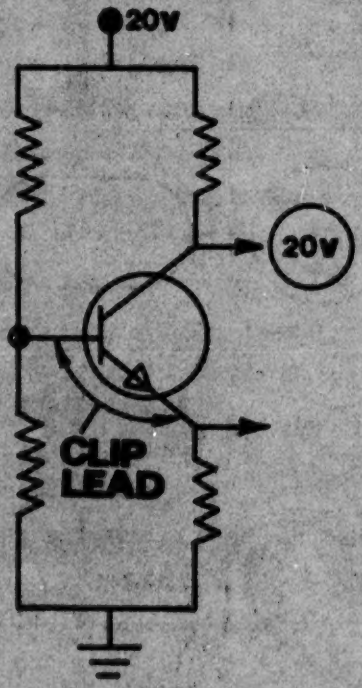
1D Have the student examine the circuit diagram in question and list all the working voltages surrounding a transistor. Opposite each voltage ask the student to describe the meaning of the measurement as it related to circuit operation.

(i.e., emitter voltage equals 2 volts. This voltage shows the actual current through the transistor by a measured voltage drop across a fixed resistance.)

2D Select a working radio for the student. Have the student make a list of all transistors. Have them measure and record all the collector voltages and record on a chart. Next, have them put a clip lead between the base and emitter of each transistor and with the clip in place record all the collector voltages on the same chart. This process of shorting the base to emitter is called the cutoff test. Testing transistors in circuit without removing them is time saving and avoids putting in and taking out parts. The cutoff test demonstrates that when zero bias is on the transistor, all the voltage drops that were a function of transistor current will go to zero and there will be a corresponding change in the voltages in the circuit as measured from ground reference.



Normal Voltages



With Cutoff Test

Zero bias or cutoff causes the collector voltages to rise to the source voltage. When you approach this in an actual circuit problem, the student should recognize that a high collector voltage indicates no current or low current is flowing in the stage. This should also be evidenced by the loss of any amount of emitter voltage.

If on the other hand when the cutoff test is applied, the voltage on the collector does not rise to the source, then the transistor must be shorted.

3D Have the student disable the output of the main power supply and insert a substitute power supply of the exact voltage level required by the circuit. Normal operation of the system should be checked to verify the experiment.

4D Have the student place a meter at the emitter of an amplifier stage that has an emitter resistor. Next, ask the student to attach a power supply to the base terminal and vary the base voltage until the correct reading as per schematic is obtained at the emitter terminal.

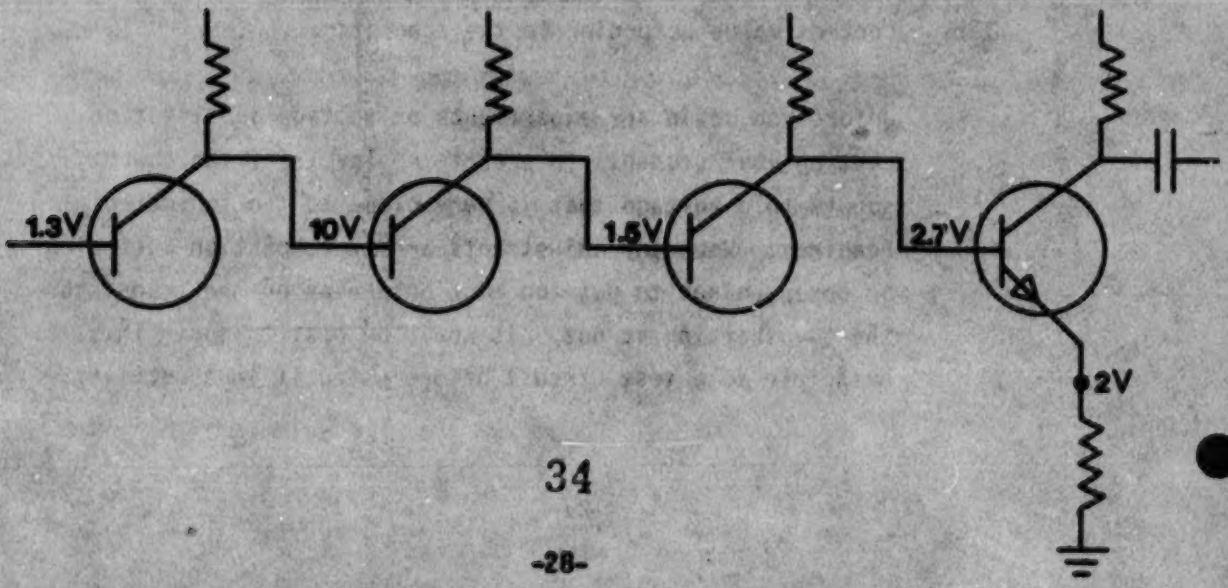
Next, have the student place a meter at the collector of the transistor amplifier. Ask the student to adjust the base voltage again until the meter at the collector reads the correct value according to the schematic.

Before you begin any experiments on voltage substitution caution your students to preset the levels of the power supply to a voltage that is very close to the schematic readings. When any adjustments are made, caution must also be observed not to put too much base bias on the transistor thereby shorting it out. It would be best to apply this principle to a test circuit before using it in a receiver.

The objective we are teaching is that when a manufacturer designs a base bias circuit, certain no signal currents will flow in the emitter and collector circuits that will result in certain voltage readings due to the voltage drops. These readings are posted on a schematic diagram. If we measure incorrect voltages around the device, two possibilities as to the cause exist.

1. Incorrect voltages caused by component failure.
2. Incorrect voltages caused by transistor failure.

Substituting voltages will tell you if it is the transistor. If you put in correct base voltages and correct readings followed on the emitter and collector, then the transistor is probably okay. This may seem like a long way around to isolate a single transistor, but consider direct coupled circuits where conduction of one transistor determined the bias of the next, etc. This is the only way of speedily testing for failure in those circuits. The application is the same in direct coupled circuits as on a single stage. The only difference is that the meter should be placed in the emitter circuit of the last amplifier stage. See the diagram below for illustration.



1. Attach the meter to the emitter of Q4.
2. Adjust the base bias of Q4 to 2.7 volts.
3. Adjust the base bias of Q3 to 1.5 volts.
4. Adjust the base bias of Q2 to 10 volts.
5. Adjust the base bias of Q1 to 1.3 volts.

At each point you should be able to adjust the correct base bias and the emitter voltage on Q4 should read 2 volts. If, when you clamp the base voltage on one of the transistors, you don't get the 2 volts, then you have found a defective transistor.

LEARNING BLOCK #4
DISCRETE ANALYSIS: "How does it do it?"

Having reached this point you will have a student who understands and can demonstrate the basic principles of circuit operation. To "sharpen" up their troubleshooting skills competencies from the fourth block, "Discrete Analysis," should be selected. These are the "indepth" concepts which all students may not completely master the first time through but will make those who succeed in demonstrating competency a better technician.

It is in this fourth block that you may wish to take the student back through some of the basic theory concepts and dwell a little deeper into each subject area. The amount of application that the student has experienced in servicing products will now give them greater insight into the "useful" principles that we strive to get across when they began their training as a radio and TV technician.

The following is an index summary of the competencies by areas within the Discrete Analysis Block. This is followed by the listing of each individual competency outlined in the index. Before you begin to select competencies from the Discrete Analysis Block, refer to the section of this guide which is titled, "Teaching Principles for Discrete Analysis." Outlined in this area is a general discussion of how you may apply some teaching techniques to satisfy the competency you may select.

INDEX SUMMARY FOR LEARNING BLOCK #4 - DISCRETE ANALYSIS

AREA A, DEVICE PARAMETERS

- 1A How Devices Amplify
- 2A Estimating Voltage Failure
- 3A Measuring Voltage Failure
- 4A Analyzing Transistor Data

AREA B, CIRCUIT PARAMETERS

- 1B Circuit Configurations
- 2B Estimating Circuit Impedances
- 3B Estimating Beta
- 4B Estimating Voltage and Current Gains

AREA C, DC ANALYSIS

- 1C Establishing Voltage Paths
- 2C Analyzing Voltage Action of Controls
- 3C Estimating Schematic Values
- 4C Proving Schematic Values

AREA D, AC ANALYSIS

- 1D Analyzing Resonant Circuit Adjustments
- 2D Analyzing Signal Action of Controls
- 3D Peak Aligning Resonant Circuits
- 4D Sweep Aligning Resonant Circuits

LEARNING BLOCK #4 DISCRETE ANALYSIS

"How Does it Do It?"

AREAS:
- A. Device Parameters
- B. Circuit Parameters
- C. DC Analysis
- D. AC Analysis

AREA A, DEVICE PARAMETERS

1A Describe, in as much detail as needed, how a transistor or a vacuum tube can amplify a signal voltage.

2A Given a schematic of a working receiver, estimate what would happen to the measured emitter, base and collector voltages if the following conditions were put into the circuit: Open emitter resistor, open base resistor, open collector resistor, emitter to collector short, base to emmitter short, and base to collector short. Make a chart for the estimated voltage changes.

3A Put into the circuit the problems as outlined in 2A above. Measure the emitter, base, and collector voltages that occurred during each problem. Chart the results and compare with the estimated values you recorded in #2A above.

4A Obtain a chart of the characteristics of a particular transistor. Write a summary relating the given data in the chart to possible use in troubleshooting a circuit.

AREA B, CIRCUIT PARAMETERS

1B Describe the type of circuit configuration used for each device. (Common base, common emitter or common collector-emitter follower.)

2B Estimate the Beta of the device used by calculation from given schematic values.

3B Estimate the voltage or current gain by calculation from given schematic values.

4B Given a working receiver and using a sweep alignment generator set to provide the correct output, sweep align the resonant circuits as outlined by manufacturer.

AREA C, DC ANALYSIS

1C Given a schematic of a receiver, trace over the schematic with a colored pen the voltage path from each terminal of the transistor to the main voltage source.

2C Vary each resistive adjustment located in the circuit. Make a chart showing the voltage changes between maximum and minimum settings of the controls.

3C Calculate, using schematic values, the voltage levels that should appear at each terminal of the transistor. Make these calculations given transistor Beta.

4C Describe the differences between the schematic calculated values of #3C and the circuit measured values. Explain any differences.

AREA D, AC ANALYSIS

1D Outline the procedure recommended by the manufacturer to make any adjustments to resonant circuits shown in the schematic.

2D Locate all controls shown in the section of the schematic under consideration. Explain in detail how each control functions to control the signal level.

3D Given a working receiver and using a signal generator set to the correct frequency peak, align resonant circuits as outlined by the manufacturer.

4D Given a working receiver and using a sweep alignment generator set to provide the correct output, sweep align the resonant circuits as outlined by the manufacturer.

TEACHING PRINCIPLES FOR DISCRETE ANALYSIS: BLOCK #4

AREAS:
- A. Device Parameters
- B. Circuit Parameters
- C. DC Analysis
- D. AC Analysis

The competencies described in this section can be applied to a post-high school Training program or used in a high school program with a full vocational Electronics Program. This material should be used with textbooks that give a detailed breakdown of various circuits under consideration.

AREA A, DEVICE PARAMETERS

1A It is important that each student understand the parameters that make the amplifier device operate correctly and how it will function under abnormal voltage or bias conditions. Have the student consider how each type of amplifier device functions to amplify a signal. Ask the student to write a summary explaining the exact way a tube or transistor can simplify a signal. Have them pick out a particular stage in a schematic to use as a reference for their explanation.

2A Have the student obtain a schematic of a radio or TV. Ask them to choose a stage to analyze. Have the student list all the voltages around the device that makes the stage function properly. Give the student an example problem such as: "Emitter resistor opens up" and ask the student to estimate what would happen to each of the voltages they listed.

Example: Emitter voltage would go to zero.
Base voltage would rise slightly.
Collector voltage would rise to source.

Give the student the following example problems and have them estimate voltage changes for each condition:

1. Open emitter resistor
2. Open base resistor
3. Open collector resistor
4. Emitter to collector short
5. Base to collector short
6. Base to emitter short

Repeat this analysis on several stages as time allows.

3A Obtain a working radio or construct a test circuit. Ask the student to repeat the problems described in 2A, 1 through 6, inserting each problem into the circuit one at a time. Have the student chart the results and compare to the results obtained in item 2A. In addition to recording the actual measurements, have the student use arrows in each block to indicate a decrease or increase in the values. See the chart below for an example of this procedure.

Circuit Condition	Estimated Voltage Changes			Measured Voltage Changes			Explain Discrepancy
	E.	B.	C.	E.	B.	C.	
1. Open emitter resistor	Ø ↓	3.2v ↑	15v ↑	Ø ↓	3.3v ↑	15A ↑	No major differences
2. Open base resistor	Ø ↓	Ø ↓	15v ↑	Ø ↓	Ø ↓	15A ↑	Same
	Continue as outlined.						

4A Transistor data manuals provide much information about the characteristics of each transistor. The question that the students need answered is to what extent does this data apply to radio and TV repair. The primary emphasis should be directed toward a thorough knowledge of substituting transistors. This requires a good understanding of what the transistor data means. Have the student define the data and ask the student to choose a transistor on a schematic and find a workable substitute by interpreting the data shown for substitute transistors and not using the transistor substitute listings.

AREA B, CIRCUIT PARAMETERS

1B Using a schematic of a receiver system, have the student identify the exact type of circuit configuration of each device. Using general terminology, have the student indicate the impedance, voltage gain, and current gain of each type of circuit configuration. Example: Common collector type.
High input impedance.
Low output impedance.
Loss of voltage gain.
High current gain.

2B Using a schematic that has all the measured values listed, the student should be able to calculate the base and collector currents. From these values they should be able to obtain beta values for the transistors.

3B Given a schematic of a receiver system, have the student approximate the values of voltage or current gains for each stage in question. Use schematic values and the proper "rule of thumb" formula given in transistor training manuals.

4B Given a schematic of a receiver system, have the student approximate the values of input and output impedance of each

stage in question. Use schematic values and the appropriate "rule of thumb" formula given in transistor training manuals.

AREA C, DC ANALYSIS

1C Finding the source of supply voltage for different transistor bias is sometimes confusing when the student is looking at a complete system. If the student has colored pens, have them use a different color for each bias circuit of the transistor: collector, emitter and base. Ask them to trace each circuit from the measured voltage point to the source, indicating each resistor that effects the particular measured bias voltage.

2C Have the student identify each control in the receiver by its function. Ask the student to describe in detail what effects varying the control from maximum to minimum will have on surrounding bias voltage readings.

3C Schematics do not always include all specified bias voltage measurements, and sometimes you will have to service a unit without knowing the proper voltage levels. In this situation it is important for the student to be able to estimate circuit voltages. Give the student a schematic of a particular stage in a receiver with no bias voltages listed. give the student as little information as possible about the stage and ask them to compute the voltage levels that should exist at each terminal of the transistor. This is a good exercise in applying the basic theory of Ohms law to basic transistor operation. You will usually need to specify the Beta and the amount of collector current.

4C If you have a working receiver or a test circuit that can be used for item 3C above, have the student measure all the values that were just estimated. The student should make a

comparison between the estimated and measured values and analyze any significant differences. These last two exercises are particularly useful when you wish to know the voltage levels that should be present with the transistor removed from the circuit under test.

AREA D, AC ANALYSIS

1D Have the student obtain the full service data on a particular receiver. (Sams Photofact, etc.) Ask the student to outline the procedure recommended to set the resonant circuits. This should be a general summary and not a specific step by step procedure. The importance of receiver preparation and specific test points should be emphasized.

2D Most controls in the receiver control the amount of signal coming out of a particular stage. Have the student describe in detail how each control functions to provide this signal variation.

3D Each resonant stage in the receiver will have a peak frequency at which the output should be maximum. If the manufacturer service manual provides this data, have the student tune each stage for maximum output at the desired frequency.

4D Obtain the manual for the type of sweep alignment equipment you have. Have the student study the recommended use of the equipment and become familiar with the controls. Next, let the student study the service manual of the receiver under-test to identify the recommended procedure for a sweep alignment. Before the student actually aligns a stage, have them hook up the equipment to two or three receivers and simply observe the different alignment curves that are obtained. The last step is to have the student adjust the resonant circuits to obtain the proper sweep alignment curve as specified by the manufacturer.

SHOPPING LIST OF COMPETENCIES FOR TV REPAIR

The Television System

1. Identify the proper answer to questions related to how a TV transmitter converts picture and sound into electromagnetic waves.

2. Identify how a TV receiver converts electronic signals into picture and sound.

3. Explain two ways of intensity modulation of the beam from zero to maximum brightness.

4. Explain the purpose of the following: Deflection yoke, centering devices pincushion magnets, focus devices, electron lens, and aluminized surface.

The TV RF Tuner

1. Draw the block diagram of a VHF RF tuner from a TV schematic.

2. Explain the path of signal flow through the three RF tuner functions of a TV tuner schematic.

3. Given a tuner schematic, label the functional use of the parts listed on a TV tuner parts list.

4. Demonstrate the proper method of spray cleaning a TV tuner.

5. Identify the causes of snow in the picture on the CRT.

6. Jig up the TV tuner from a working set to a set with a nonworking tuner.

7. Demonstrate the different types of adjustments to set the oscillator.

8. Jig up a separate tuner from an external power supply (use tuner subber).

9. Demonstrate how you would determine a faulty tuner with the following generators: AM generator, TV analyst, Color Bar Generator.

10. Describe symptoms that differ between solid state tuners and tube tuners.

11. Describe the methods used to provide for UHF reception.

IF Circuits

1. Draw the block diagram of a standard IF circuit from a TV schematic.

2. Describe the basic functions of the IF circuit block diagram.

3. Explain and trace the path of signal flow through the IF stages of a TV receiver.

4. Describe the basic requirements for an IF circuit in a TV system.

5. Describe which stages are gain controlled by the AGC system.

6. Troubleshoot IF stages, locating defective signal paths.

7. Draw the bandwidth requirements of a video IF amplifier.

8. Explain the purpose and function of parallel resonant traps, series resonant traps, and absorption traps used in video IF amplifiers.

9. Write the different methods of coupling used in video IF amplifiers.

10. Use a signal generator to measure the voltage gain of each stage.

Automatic Gain Control Circuits

1. Describe the basic requirements of a keyed AGC system.

2. Trace the path of signal flow through a keyed AGC system.

3. Relate the difference between simple AGC and keyed AGC.

4. Relate the difference between forward AGC and reverse AGC.

5. Explain delayed AGC.

6. Simulate the AGC circuit action in a lab receiver.

7. Recognize video waveform necessary for proper AGC action using Oscilloscope.

8. Recognize keying waveform necessary for proper AGC action using Oscilloscope.

9. Observe DC level changes as a function of video level changes.

10. Diagnose circuit troubles related to an AGC malfunction.

Sync Circuits

1. Describe the basic functions of a sync circuit.

2. Trace the path of signal flow through the sync circuit of a TV receiver.

3. Explain how sync is removed from a composite video signal.

4. Relate limiter action to a sync signal.

5. Explain differentation of a horizontal sync pulse.

6. Explain integration of a vertical sync signal.

7. Explain how noise immunity is obtained in sync circuits.

8. Explain the operation of a sync separator circuit.

9. Trace sync flow from separator through individual components to vertical oscillator and horizontal AFC input.

10. Explain information contained in the VITS signals for diagnosis of TV receiver related problems.

11. Diagnose circuit troubles related to sync malfunction.

Video Amplifier Circuitry

1. Describe the basic functions of a video amplifier block diagram.

2. Explain the basic requirements of a TV video amplifier pertaining to bandwidth, required number of stages, and gain needed.

3. Identify various frequency related components located in the video amplifier (coupling cap, bypass cap, peaking coil, etc.).

4. Inject a signal of suitable frequency for the purpose of locating an open in the video amplifier string.

5. Using an oscilloscope trace the video signal from the detector to the CRT.

6. Utilize a square wave generator in diagnosis of video amplifier circuits.

7. Utilize a color bar generator in diagnosis of video amplifier circuits.

8. Utilize a pattern generator (B & K analyst) in diagnosis of video amplifier circuits.

9. Define the Miller Effect.

Vertical Circuits

1. Explain the block diagram of a complete vertical sweep section in a receiver.

2. Understand basic sweep oscillator requirements.

3. Recognized differentiated waveforms.

4. Recognize integrated waveforms.

5. Explain how, in nonsinusoidal circuits, inductance changes the waveshape of voltage compared to current.

6. Simulate a sweep signal necessary to isolate vertical oscillator circuit problems.

7. Explain the multivibrator system used in vertical sweep section.

8. Relate how vertical linearity and height are controlled in the sweep system.

9. Troubleshoot vertical output section by substituting signals with a TV analyst, or 60 Hz signals present in the receiver.

Horizontal AFC and Oscillator

1. Explain the block diagram of a horizontal AFC section of a TV receiver.

2. Explain the operation of the horizontal frequency control from the AFC circuit.

3. Relate pulse width and pulse height AFC operation to control circuitry.

4. Explain sine wave components in horizontal oscillators.

5. Be able to properly phase a sine wave coil and examine the oscillator frequency with no sync input.

6. Troubleshoot an AFC section of a TV receiver.

7. Troubleshoot the oscillator section of a TV receiver.

8. Describe the different types of oscillators used for horizontal sweep.

9. Simulate the oscillator signal with an external generator to test the stage.

Horizontal Sweep Circuit

1. Explain the block diagram of the horizontal output system of a TV receiver.

2. Relate fundamentals of horizontal driver circuits.

3. Describe and measure signal (AC) requirements to horizontal output tube/ transistor devices.

4. Describe and measure DC bias requirements to operate the horizontal output system.

5. Use logical troubleshooting procedures to isolate horizontal output trouble.

Horizontal Output High Voltage Section

1. Explain how high voltage is generated in a TV receiver.

2. Understand the function of the damper circuit and relate the damper circuit to sweep produced on screen.

3. Explain how boost voltage and focus voltage are generated.

4. Explain the control action of a shunt and pulse type high voltage regulator circuit.

5. Troubleshoot high voltage problems in a receiver.

6. Set the horizontal efficiency coil per manufacturer specs.

7. Trace out four different types of HV protection hold down circuits and explain how they function to control high voltage.

8. Explain how scan rectification works to provide a source of B+ voltage.

Colorimetry

1. Describe colors in terms of wavelengths.

2. Explain luminosity values to colors.

3. Explain tristimulus value to colors.

Color Transmission

1. Describe the makeup of a color signal.

2. Describe the action of adding modulation in the form of croma information to a 3.58 mHz carrier and obtaining only outputs of 3.58 mHz sidebands.

3. Relate the Hue to be produced by croma modulation to vector relationships of carrier phase to modulation phase.

Color Receivers

1. Draw the block diagram of the color section from a receiver schematic.

2. Trace the flow of color signals on the schematic using colored pens to highlight signal flow from the video amplifier to the picture tube.

3. Trace the flow of a color signal using an oscilloscope from the video amplifier to the picture tube.

Color Killer - Color Sync - Color ACC

1. Describe the basic operation of a color killer circuit.

2. Measure voltage changes and waveforms needed to control killer operation.

3. Describe the basic operation of the ACC amplifier circuit.

4. Measure voltage changes and waveforms needed to control ACC operation.

5. Describe the action of the burst signal as it applies to color sync.

6. Describe the phase differences between colors generated by a color bar generator relative to burst.

7. Explain direct sync in a color oscillator circuit.

8. Explain how a reactance control circuit works to control the color oscillator frequency.

9. Detail the step-by-step procedure needed to set the AFPC.

10. Describe the action of the burst signal as it applies to sync in the color oscillator to produce the proper phase for demodulating the proper hue.

Demodulators

1. Explain the hue produced by the demodulator to vector addition of oscillator phase to modulation phase.

2. Relate the differences in demodulation between I & Q - R-Y, B-Y, and X and Z.

3. Identify the hue being produced by examining the demodulated color bar pattern at the grid of the color picture tube.

4. Describe diode usage in demodulator circuits.

5. Explain the meaning of high level and low level demodulation.

6. Describe how demodulated signals can be added back into video circuitry at the CRT cathode.

7. Explain how G-Y signals are obtained from B-Y and R-Y outputs.

8. Explain The amplitude variations of the I & Q croma signal present in the demodulator to produce a change of hues.

9. Describe the action of a sheet-beam demodulation.

Matrix Section

1. Relate the luminance signal at the cathode to the color signal at the grid for a given color produced.

2. Describe the difference between R-Y and B-Y matrix and X and Z matrix.

3. Describe the need for providing DC restoration to the signal.

4. Explain the operation of a DC clamp circuit.

Color TV Alignment

1. Demonstrate a working knowledge of alignment equipment.

2. Sweep test probes used in alignment.

3. Set up circuit to be aligned and make correct hookup.

4. Peak align an IF stage.

5. Sweep align an IF stage.
6. Demonstrate the use of video sweep modulation.

"About the Vocational Skills Record"

The idea of a skills record is to provide students, teachers, and employers with some type of indicator for evaluating student progress. Teachers and students could use the skills record for grading purposes, employers could use the skills record for evaluating what a possible employee might be able to do for them on the job.

The skills record is divided into three areas: 1) Basic Theory Concepts, 2) Specialty Concepts, and 3) Equipment Knowledge. To use the skills record, competencies for each block need to be identified. When you have a student that has satisfied the competency requirements for a particular subject, the block can be initialed and checked off. Most of the skills record is listed by the normal progression we follow in the classroom; however, it is not meant to specify any order in your teaching assignments. The record should be used only as a checklist.

Sample Curriculum

Most curriculums begin with a study of basic theory principles and follow up with product training. The most important aspect of curriculum development is the product training. It is important to introduce the student to repair logic as soon as possible for two reasons:

1. To provide the student with an application in the study of basic theory concepts. Students must be able to relate theory concepts to trouble-shooting procedures, otherwise they will develop into a "textbook technician." The student should recognize as soon as possible that there can be a big gap between knowing the material and applying that knowledge.

2. Most students enter this field because they like to fix things, and have a good mechanical aptitude. If we emphasize only theory concepts at first they are likely to loose interest and drop out.

The following curriculum outlines are for general information only. The theory vs. lab hours for each course will provide the most use in developing a curriculum. The first curriculum outined is for a one-year certificate program and the second outline for a two-year associate degree program.

Television-Radio Service Curriculum*

Class Hours	Lab Work	Course Title	Course No.	Term Units
Term 1				
12		DC Theory and AC Theory	4.255	9
	6	DC Theory and AC Theory Lab	4.256	2
6		Electronic Devices	4.257	5
	6	Electronic Devices Lab	4.258	2
Term 2				
3	6	Transistors and Circuits Theory	4.259	5
2		Electronic Principles	4.262	2
	6	Electronic Principles Lab	4.263	2
2		Use of Instruments I	4.260	2
3		Television Principles	4.266	3
	8	Television Principles Lab	4.267	3
Term 3				
2		Radio Servicing	4.264	2
	6	Radio Servicing Lab	4.265	2
3		Television Servicing	4.268	3
	8	Television Servicing Lab	4.269	3
2		Use of Instruments II	4.261	2
3		FM and HIFI Theory	4.270	3
	3	FM and HIFI Theory Lab	4.271	1
3		Business Management	2.202	3

*Courtesy Chemeketa Community College

Class Hours	Lab Work	Course Title	Course No.	Term Units
Term 4				
3	6	Color Television Servicing	4.273	5
3	3	Solid Stage Servicing	4.272	4
3	3	Logical Trouble Shooting	4.274	4
1	8	Cooperative Work Experience	2.687	3

Electronic Servicing Technology*
2-Year A.S. Program

			Term Credit	Theory	Lab
FIRST QUARTER					
ES	10	Basic Electronic Theory	2	2	0
ES	13	Direct Current	4	2	4
ES	16	Electronic Circuits	3	1	4
ES	18	Basic Electromechanics	2	1	3
MTH	14	Mathematics I	3	3	0
HE	252	Standard First Aid	3	3	0
PO	185	Physical Education	1		
			18		
SECOND QUARTER					
ES	11	Electronic Servicing	2	1	3
ES	14	Alternating Current	3	2	4
ES	17	Semiconductors	3	1	4
ES	26	Logic Systems	2	1	3
MTH	15	Mathematics II	3	3	0
BUS	20	Small Business Operation	3	3	0
PE	185	Physical Education	1	3	
			17		

*Courtesy Mt. Hood Community

THIRD QUARTER			Term Credit	Theory	Lab
ES	12	Frequency Modulation	4	2	4
ES	24	Amplifier Analysis	4	2	4
ES	25	Complex AC Circuits	3	2	3
ES	27	Audio: Product Analysis	2	1	2
BUS	17	Salesmanship (or BA 238)	3	3	0
PE	185	Physical Education	1	3	0
			17		

FOURTH QUARTER					
ES	20	Television I	7	5	7
WE	40TE	Cooperative Work Experience	5		
ENG	28	Communication Skills I	3		
PE	185	Physical Education	1		
			16		

FIFTH QUARTER					
ES	21	Television II	7	5	7
WE	40TE	Cooperative Work Experience	5		
ENG	29	Communication Skills II	3		
PE	185	Physical Education	1		
			16		

SIXTH QUARTER					
ES	22	Television III	7	5	7
ES	23	License Preparation	2		
WE	40TE	Cooperative Work Experience	5		
			14		

TEXTBOOKS

Textbooks may serve the student in two ways:

1. As the primary instrument used by students in the study of a course.

2. As a resource to supplement individualized learning program material.

Textbook learning is a part of most all curriculums. It becomes the authority and creates the style of learning that takes place in the classroom. It is important that the book selected follows your teaching style as laboratory applications usually follow textbook study. If information for lab experiments are not identified in the text, you will have a student who quickly stops reading the text assignments.

This does not mean that the text should include lab experiments, but it should give information that will assist students to meet lab goals. Before implementing any of the texts in your classroom, write the publisher for an examination copy to study.

The three most popular publishers are listed below. Write for a free catalog illustrating texts available for use in an electronic service program.

McGraw-Hill
1221 Avenue of the Americas
New York, NY 10020

*Electricity & Electronics Catalog

*Technical and Occupational Catalog

Prentice Hall
Englewood Cliffs, NJ 07632

Howard Sams Company
4300 West 62nd Street
Indianapolis, IN 46206

*Sams Book Catalog

Sample Texts

Radio/TV Apprenticeship training materials recommended by the Electronics Industry Association (EIA):

Basic Electricity, Zbar, McGraw-Hill
Basic Electronics, Zbar, McGraw-Hill
Basic Radio: Theory and Serving, Zbar, McGraw-Hill
Television Symptom Diagnosis, Student Manual
Television Symptom Diagnosis, Text Manual
Basic Television: Theory and Servicing, Zbar, McGraw-Hill

The following is a list of texts frequently used to train radio/TV technicians:

Basic Theory: Basic Electronics, Grobe, McGraw-Hill
Basic Electricity for Electronics Blittzer, Wiley
Programmed Learning: DC Circuits, Westinghouse Learning Press
AC Circuits, Westinghouse Learning Press
Health Kit

A Programmed Course in Basic Electricity, New York Institute of Technology, McGraw-Hill

Mathematics: Basic Mathematics for Electronics, Cooke and Adams, McGraw-Hill

Electronic Devices: Electronic Principles, Malvino, McGraw-Hill
A programmed Course in Basic Transistors, New York Institute of Technology, McGraw-Hill

Troubleshooting: Solid State Servicing, Slooth, Sams, Electronic Troubleshooting, Philco Technician Institute, Prentice-Hall

Radio: Elements of Radio by Marcus and Marcus, Prentice Hall
Elements of Radio Servicing Marcus and Levy, Prentice Hall

TV: Basic Television, Grobe, McGraw-Hill
Transistor Color TV Servicing Guide, Middleton, Sams
Color TV Training Manual, Sams
Color TV Training Manual, Herrick
Color TV Training Manual, Herrick
Television Simplified, 7th Edition, Kiever and Kaufman, Delmar

Supplemental Classroom Aids

Free Manuals:

"Nortronics Recorder Care Manual"
c/o Nortronics Company, Inc.
8101 Tenth Avenue North
Minneapolis, MN 55427

Pioneer: "Understanding High Fidelity"
c/o U.S. Pioneer Electronics Corporation
75 Oxford Drive
Moonachie, NJ 07074

Your best resource for supplemental materials (free of cost) is the Electronics Industry Association (EIA). They can supply you with a career guidance brochure entitled, "Futures Unlimited." A film illustrating the electronics service technician career opportunities is also available upon request. Write to:

Consumer Electronics Group
Electronics Industries Association
2001 Eye Street NW
Washington, DC 20006

Ask for a copy of their multimedia handbook for electronics. It gives sources for the following media items:

1. Super 8 mm film loops
2. 16 mm films

3. Videotapes
4. Slides
5. Filmstrips
6. Tape scripts
7. Tapes
8. Transparencies
9. Charts

Technical Literature

RCA: Product technical manuals 1970 through 1977
Color chasis technical manuals for:
CTC 85 color chasis (current 1977)
CTC 49 color chasis - transvista 100 chasis
CTC 40 - titled "Solid State Color Television"
CTC 47 - titled "The Two Thousand Technical Manual"

Each model year of the product technical manual covers the products and a summary of each new chasis. The color chasis technical manuals give an indepth description of each circuit in the chasis. Any of these manuals are highly recommended.

RCA Mini Manuals:

Basic Test Equipment, Book 1	TR61017
Basic Test Equipment, Book 2	TR61194
Color Television Horizontal Deflection and H.V.	TR70TR8-1
Portable Color TV	TR60183-2
Compact Color TV	TR60080
AC-Battery Transistor TV, the KCS157	TR60180
The Transistor in Practical Circuitry	TR60042
Servicing Solid State	TR60041
Transistor TV Circuitry	TR60098

Field Training Workshop Manuals:

Workshop #2	Solid State Television, Basic Servicing Technique
Workshop #4	Serving the CTC 38 Color Chasis
Workshop #5	Servicing the CTC 40 Color Chasis
Workshop #6	Test Equipment and Applications
Workshop #7	Color Television Alignment Techniques
Workshop #8	Servicing the Modular Solid State Color Chasis
Workshop #9	Servicing the XL100 Modular Color Chasis
Workshop #10	Servicing Techniques Portable Color TV
Workshop #12	Chroma Servicing Hybrid Color TV
Workshop #14	Servicing XL100 Signal Processing Circuitry
Workshop #15	Servicing XL100 Color Track CTC 74 and CTC 81
No Number X	Servicing Color Television Horizontal Deflection and High Voltage Circuits
No Number X	Servicing Color Chasis CTC 46
No Number X	Servicing the CTC 44 Color chasis

G.E:	Television Service News (Free)
	Technical Training Manual U1 Chasis
	Technical Training Manual UA Chasis
G.E.	Symptom Repair Manual
Motorala:	Color TV Technician Training Series
Zenith:	Technician Participation Workshop
	TPW #1 (1973 Product Analysis)
	TPW #2 (1974 Product Analysis)
	TPW #3 (1975 Product Analysis)
	TPW #4 (1976 Product Analysis)
	Technical Training Program
	#TP5 (Features mid-1970 color chasis)
	#TP6

Audiovisual Aids

RCA Slide/Tape:

RCA Transistor Servicing, Part 1
Covers: Basic techniques for transistor checking.

RCA Transistor Servicing, Part 2
Covers: Identifying the defective stage.

RCA Transistor Servicing, Part 3
Covers identifying and replacing the defective component.

RCA Television Servicing, Part 1
Covers: No raster condition.

RCA Color Picture Tubes, Part 1
Covers: Basic installation procedure and adjustments and includes removal and replacement and static convergence.

RCA Color Picture Tubes, Part II
Covers: Basic installation procedure and adjustments and includes dynamic convergence tracking.

Zenith:

Sight and Sound Schematics	25DC56
Sight and Sound Schematics	17/19EC45
Sight and Sound Schematics	4B25C19
	25DC56/57

The above sight and sound manuals come with a cassette tape and book. These are excellent television training aids.

To obtain any technical literature for RCA Products, write:

RCA Consumer Electronics
600 North Sherman Drive
Indianapolis, IN 46201

To obtain RCA Audio/Visual Aids, write:

North Pacific Supply, Inc.
2950 NW 29th
Portland, OR 97208
Attention: Parts Department

To obtain Zenith technical literature and audio or visual aids, write:

Zenith Radio Corporation
1900 N Austin Avenue
Chicago, IL 60639

To obtain GE technical literature, write:

General Electric Company
Television Product Service
Television Receiver Products Department
College Park
Portsmouth, VA 23705

To obtain GE Television Service News, write:

General Electric Company
Television Receiver Dist., Seattle Zone
401 Tukwila Parkway
Seattle, WA 98188

To obtain GE Symptom Repair Manual, write:

"Dutch" Meyer
General Electric Company
College Boulevard
Portsmouth, VA 23705

To obtain information from Admiral, write:

Admiral Group, Rockwell International
1701 E. Woodland Road
Schaumburg, IL 60196

To obtain information from Sylvania, write:

GTE Sylvania
700 Ellicott Street
Batavia, NY 14020

To obtain information from Hitachi, write:

Hitachi Sales Corporation
401 W Artesia Boulevard
Compton, CA 90220

To obtain information from Magnavox, write:

Magnavox
1700 Magnavox Way
Fort Wayne, IN 46804

To obtain information from Curtis Mathis, write:

Mathes, Curtis
Box 151
Athens, TX 75751

To obtain information from Panasonic, write:

Panasonic
1 Panasonic Way
Secaucus, NJ 07094

To obtain information from Philco, write:

Philco Consumer Elect. Division
Entertainment Products
Group GTE Sylvania
700 Ellicott Street
Batavia, NY 14020

To obtain information from Quasar, write:

Quasar Electronics Corporation
9401 W Grand Avenue
Franklin Park, IL 60131

To obtain information from Sanyo, write:

Sanyo Electric, Inc.
1200 W Artesia Boulevard
Compton, CA 90220

To obtain information from Sharp, write:

Sharp Electronics
10 Keystone Place
Paramus, NJ 07652

To obtain information from Sony, write:

Sony Corporation of America
9 West 57th Street
New York, NY 10019

To obtain information from Toshiba, write:

Toshiba America, Inc.
280 Park Avenue
New York, NY 10017

SUMMARY

Individualized curriculum material has been written, for the most part, by many individuals, each with a writing and teaching style of their own. This results in some confusion when combining the use of all the materials in one program. Many instructors have to pick and choose learning material that fits their style for classroom use.

The objective of this guide was to provide a theme in the instruction of radio and TV repair by creating competencies which have been identified by the Electronics Service Industry into progressive learning blocks.

Now the instructor may use a selection of different material and as long as the basic theme of this guide is followed, standardized learning patterns will develop for each subject you study. If you develop any written material for individualized program use, the guide can serve as a tool to keep the instructional material consistent within the framework of teaching electronic servicing to students.

Students benefit most by learning those competencies which prove successful on the job. A second important benefit to the student is yet to be developed; the transferability of students between programs in different colleges and from high school to community college. If standardized levels of mastery that were suggested in this guide are followed, students should be be able to keep all the credits earned from a high school program or a community college when transferring to another facility. Any encouragement we give to students at a high school level will be returned many fold by supplying colleges with interested learners whose goals are already set to become a radio/TV service technician.

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

INSTRUCTIONS:

List each manipulative and knowledge skill relating to the job listed above. To the right of the page are three sections of columns asking specific questions about the Entry Level, Frequency of Performance and Instruction Attained At. An "X" should be placed, by the analyst, opposite each task in the appropriate box of the "ENTRY LEVEL" and "FREQUENCY OF PERFORMANCE" sections. Section three, "INSTRUCTION ATTAINED AT" is to be completed by state representative persons selected by the state department specialist.

Duty No.	Task No.	Task Description	Entry Level		Frequency of Performance			Instruction Attained at			
			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
1	0	Performs Office Tasks									
	1	Price out service charges on order	X				X				
	2	Price out materials charges on order	X				X				
	3	Compute repair time	X				X				
	4	Write understandable report of work done	X				X				
	5	Make out warranty forms	X				X				
	6	Schedule service calls by priority	X				X				
	7	Schedule service calls by geography of area	X				X				
	8	Inform customer of charge for service	X				X				
	9	Question customer without offending	X				X				
	10	Take customer order for service	X				X				
	11	Identify warranty status of parts of labor		X			X				
	12	Use parts catalog to order replacement part	X				X				
	13	Fill out work order correctly	X				X				
	14	Use correct spelling	X				X				
	15	Use legible handwriting	X				X				
	16	Practice personal hygiene	X				X				
	17	Add columns of numbers	X				X				
	18	Compute percentages and discounts	X				X				
	19	Make change correctly	X				X				
	20	Explain work done in lay terms	X				X				
2	0	Delivers and Installs TV Sets									
	1	Drive delivery truck	X				X				
	2	Operate moving dollies	X			X					
	3	Locate delivery address	X				X				
	4	Remove and drive screws	X				X				
	5	Remove and tighten bolts	X				X				
	6	Connect and disconnect electric jacks and plugs	X		X						
	7	Dress or position wiring	X				X				
	8	Use wiring diagram to make electric connection	X				X				
	9	Use assembly and disassembly instructions	X				X				
	10	Relate picture defect to customer regarding control misadjustment	X				X				
	11	Relate sound defect to customer regarding control misadjustment	X				X				
	12	Correct picture defect by adjusting customer controls	X				X				
	13	Correct audio defect by adjusting customer controls	X				X				
	14	Instruct customer on correct use of controls	X			X					
	15	Relate picture defect to service control misadjustment	X				X				
	16	Relate sound defect to service control misadjustment	X				X				

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2	17	Correct picture defect by adjusting service controls	X				X				
	18	Correct sound defect by adjusting service controls	X			X					
	19	Do color convergence with instructions	X		X						
	20	Do color convergence from memory	X		X						
	21	Select correct mechanical fasteners to install antenna	X			X					
	22	Select suitable location on building for antenna	X			X					
	23	Make mechanical connection to wood, metal or masonry	X			X					
	24	Select point of entry for transmission line		X		X					
	25	Make weather proof transmission line entrance	X			X					
	26	Select appropriate type of transmission line		X		X					
	27	Select appropriate type of antenna		X		X					
	28	Run transmission lines in walls		X	X						
	29	Fish transmission lines in finished walls		X	X						
	30	Install lead-in terminal boxes		X	X						
	31	Install impedance match devices on transmission line	X			X					
	32	Select signal generator for TV sound IF alignment	X				X				
	33	Connect generator for sound IF alignment	X				X				
	34	Connect oscilloscope observe sound IF bandpass curve	X				X				
	35	Identify normal or acceptable bandpass curve	X				X				
	36	Select signal generator suitable for video IF alignment	X			X					
	37	Make proper adjustment to correct abnormal curve		X			X				
	38	Connect signal generator for video IF alignment	X			X					
	39	Connect oscilloscope observe video IF bandpass curve	X			X					
	40	Connect and adjust bias control supplies	X			X					
	41	Identify normal B & W video IF bandpass curve		X		X					
	42	Identify normal color video IF bandpass curve		X		X					
	43	B + W adjustment traps and transformer to normal IF curve		X		X					
	44	Color adjustment traps and transformer to normal IF curve		X		X					
	45	Select signal generator suitable for chroma alignment	X			X					
	46	Connect signal generator for chroma alignment	X			X					
	47	Identify normal chroma waveforms and curves		X		X					
	48	Adjust traps coils and transformer to correct chroma curves	X			X					
3	0	Repairs TV Sets									
	1	Identify picture symptoms of vertical oscillator trouble	X			X					

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	2	Identify normal input/output waveforms vertical oscillator	x			x					
	3	Connect oscilloscope to observe input signal to vertical oscillator	x			x					
	4	Connect oscilloscope to observe output signal to vertical oscillator	x		x						
	5	Replace vertical oscillator module or plug in board		x		x					
	6	Identify problem requiring descrete circuit diagnosis		x		x					
	7	Identify picture symptoms of vertical output trouble	x			x					
	8	Identify normal input/output waveforms vertical output	x			x					
	9	Connect oscilloscope to observe input signal to vertical output	x			x					
	10	Connect oscilloscope to observe output signal to vertical output	x			x					
	11	Replace vertical output module or plug-in board		x		x					
	12	Identify problem requiring descrete circuit diagnosis		x		x					
	13	Identify picture symptoms of horizontal oscillator trouble	x			x					
	14	Identify normal input/output waveforms for horizontal oscillator	x			x					
	15	Connect oscilloscope observe input signal to horizontal oscillator	x			x					
	16	Connect oscilloscope observe output signal to horizontal oscillator	x			x					
	17	Replace horizontal oscillator module or plug-in board		x		x					
	18	Identify problem requiring discrete circuit diagnosis		x		x					
	19	Identify picture symptoms of horizontal output trouble	x			x					
	20	Identify normal input/output waveforms horizontal output	x			x					
	21	Connect oscilloscope to observe input signal to horizontal output	x			x					
	22	Connect voltmeter with high voltage probe	x			x					
	23	eplace horizontal output module or plug-in board		x		x					
	24	Identify problem requiring discrete circuit diagnosis		x		x					
	25	Identify picture symptoms of high voltage circuit trouble	x			x					
	26	Identify normal input/output waveforms high voltage rectifier	x			x					
	27	Use oscilloscope observe input waveforms high voltage rectifier	x			x					
	28	Connect voltmeter with high voltage probe	x			x					
	29	Identify problem requiring discrete circuit diagnosis		x		x					

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	30	Identify picture symptoms of horizontal AFC circuit trouble	X			X					
	31	Identify normal input/output waveforms of horizontal AFC	X			X					
	32	Connect oscilloscope to observe input signal to horizontal AFC	X			X					
	33	Connect oscilloscope to observe output signal to horizontal AFC	X			X					
	34	Replace horizontal AFC module or plug-in circuit board		X		X					
	35	Identify problem requiring discrete circuit diagnosis		X		X					
	36	Identify picture symptoms of sync separator trouble	X			X					
	37	Identify normal input/output waveforms of sync separator	X			X					
	38	Use oscilloscope to observe input signal to sync separator	X			X					
	39	Use oscilloscope to observe output signal of sync separator	X			X					
	40	Replace sync separator module or plug-in circuit board		X		X					
	41	Identify problem requiring discrete circuit diagnosis		X		X					
	42	Identify picture or audio symptoms of AGC circuit trouble	X			X					
	43	Identify normal input/output waveforms AGC circuit	X			X					
	44	Connect oscilloscope to observe input signal to AGC	X			X					
	45	Connect oscilloscope to observe output signal from AGC	X			X					
	46	Replace AGC module or plug-in circuit board		X		X					
	47	Identify problem requiring discrete circuit diagnosis		X		X					
	48	Identify pic symptoms of video amp trouble	X			X					
	49	Identify normal input/output waveforms video amp	X			X					
	50	Use oscilloscope to observe input signal to video amp	X			X					
	51	Use oscilloscope observe output signal from video amp	X			X					
	52	Replace video amp module or plug-in circuit board		X		X					
	53	Identify problem requiring discrete circuit diagnosis		X		X					
	54	Identify picture symptoms of picture tube circuit trouble	X			X					
	55	Identify normal input signal waveforms of picture tube	X			X					
	56	Use oscilloscope to observe input signal to picture tube	X			X					
	57	Identify problem requiring discrete circuit diagnosis		X		X					
	58	Identify picture symptom of video detector trouble	X			X					
	59	Identify normal input/output signal video detector	X			X					

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Duty No.	Task No.	Task Description	Entry Level		Frequency of Performance			Instruction Attained at			
			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	60	Use oscilloscope to observe input signal to video detector	X			X					
	61	Use oscilloscope to observe output signal from video detector	X			X					
	62	Connect signal injector to video detector input	X			X					
	63	Replace video detector module or plug-in circuit board		X		X					
	64	Identify problem requiring discrete circuit diagnosis		X		X					
	65	Identify picture sound symptoms video IF amplifier trouble	X			X					
	66	Identify normal input/output signal waveforms video IF	X			X					
	67	Use oscilloscope to observe input signal to video IF	X			X					
	68	Use oscilloscope to observe output signal of video IF	X			X					
	69	Connect signal injector to video IF amplifier	X			X					
	70	Replace video IF module plug-in circuit board		X		X					
	71	Identify problem requiring discrete circuit diagnosis		X		X					
	72	Identify picture and sound symptoms of tuner trouble	X			X					
	73	Identify normal output signal waveforms of tuner	X			X					
	74	Connect oscilloscope to observe output signal of tuner	X			X					
	75	Connect signal injector to tuner input	X			X					
	76	Replace tuner		X	X						
	77	Identify sound symptoms of sound IF amplifier trouble	X			X					
	78	Connect signal injector to sound IF input	X			X					
	79	Connect signal injector to sound IF output	X			X					
	80	Replace sound IF module or plug-in circuit board	X			X					
	81	Identify problem requiring discrete circuit diagnosis		X		X					
	82	Identify sound symptoms of FM sound detector trouble	X			X					
	83	Connect signal injector to input sound detector	X			X					
	84	Connect signal injector to output sound detector	X			X					
	85	Replace sound detector module or plug-in circuit board	X			X					
	86	Identify problem requiring discrete circuit diagnosis	X			X					
	87	Identify sound symptoms of audio amplifier trouble	X			X					
	88	Connect signal injector to input of audio amplifier	X			X					
	89	Replace audio module or plug-in circuit board	X			X					
	90	Identify problem requiring discrete circuit diagnosis	X			X					
	91	Identify picture or sound symptom of power supply	X			X					
	92	Identify normal output waveforms of power supply	X			X					
	93	Identify normal output voltages of power supply	X			X					
	94	Use oscilloscope observe voltage waveforms of power supply	X			X					
	95	Use voltmeter measure volt of power supply	X			X					

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

INSTRUCTIONS:

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	96	Use ammeter measure current power supply	X		X						
	97	Identify problem requiring discrete circuit diagnosis	X			X					
	98	Identify picture symptom of color phase detector	X			X					
	99	Identify normal input/output signal waveforms color detector	X			X					
	100	Use oscilloscope to observe color detector input signal	X			X					
	101	Use oscilloscope to observe color detector output signal	X			X					
	102	Replace color phase detector module or plug-in circuit		X		X					
	103	Identify problem requiring discrete circuit diagnosis		X		X					
	104	Identify picture symptom of color demodulator trouble	X			X					
	105	Identify normal input/output signal waveform color demodulator	X			X					
	106	Use oscilloscope to observe color demodulator input signal	X			X					
	107	Use oscilloscope to observe color demodulator output signal	X			X					
	108	Replace color demodulator module or plug-in circuit board		X		X					
	109	Identify problem requiring discrete circuit diagnosis		X		X					
	110	Identify picture symptom of convergence circuit trouble	X			X					
	111	Identify normal convergence input/output signal waveform	X		X						
	112	Use oscilloscope to observe convergence input signal	X			X					
	113	Use oscilloscope to observe convergence output signal	X			X					
	114	Replace convergence module of plug-in circuit		X		X					
	115	Identify problem requiring discrete circuit diagnosis		X		X					
	116	Identify picture symptoms of bandpass amplifier trouble	X			X					
	117	Identify normal bandpass amplifier input/output signal	X			X					
	118	Use oscilloscope to observe bandpass input waveform	X			X					
	119	Use oscilloscope to observe bandpass output waveforms	X			X					
	120	Replace bandpass amplifier module or plug-in circuit board		X		X					
	121	Identify problem requiring discrete circuit diagnosis		X		X					
	122	Identify picture symptom of burst amplifier trouble	X			X					
	123	Identify normal burst amplifier input and output signal	X			X					
	124	Use oscilloscope to observe burst amplifier input waveform	X			X					

TASK INVENTORY

TV Service and Repair
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Bob Lehman
Analyst

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	125	Use oscilloscope to observe burst amplifier output waveform	X			X					
	126	Replace burst amplifier modulator or plug-in circuit board		X		X					
	127	Identify problem requiring discrete circuit diagnosis		X		X					
	128	Identify picture symptoms of color killer trouble	X			X					
	129	Identify normal color killer input and output signal	X			X					
	130	Use oscilloscope to observe color killer input waveforms	X			X					
	131	Use oscilloscope to observe color killer output waveforms	X			X					
	132	Replace color killer circuit module	X			X					
	133	Identify problem requiring discrete circuit diagnosis	X			X					
	134	Iden pic symptoms color sub-carrier osc trouble	X			X					
	135	Identify normal sub-carrier oscillator input/output signal	X			X					
	136	Use oscilloscope to observe sub-carrier input waveform	X		X						
	137	Use oscilloscope to observe sub-carrier output waveform	X		X						
	138	Replace sub-carrier oscillator module		X		X					
	139	Identify problem requiring discrete circuit diagnosis		X		X					
	140	Identify type of rectifier circuit used	X			X					
	141	Identify operating characteristics of rectifier circuit	X			X					
	142	Identify type of filter used and its operating characteristics	X			X					
	143	Identify type of voltage regulator and operating characteristics	X			X					
	144	Identify voltage divider networks	X			X					
	145	Measure circuit voltage currents and waveforms	X				X				
	146	Identify faulty component(s) indicated by readings	X			X					
	147	Clean tuner switch contacts	X				X				
	148	Identify function of components in IF amplifier	X			X					
	149	Determine point IF amplifier signal is abnormal	X			X					
	150	Measure/interpret meaning of static voltages	X				X				
	151	Identify faulty component(s) indicated	X			X					
	152	Identify function of components video detector stage	X			X					
	153	Identify point video detector stage signal abnormal	X			X					
	154	Measure interpret meaning static voltages	X			X					
	155	Identify faulty component(s) indicated by readings	X			X					
	156	Identify function components video amplifier stage	X			X					
	157	Identify point video amplifier signal becomes abnormal	X			X					

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

INSTRUCTIONS:

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	158	Measure/interpret meaning static voltages	X				X				
	159	Identify faulty components(s) by readings	X			X					
	160	Identify function components picture tube circuit	X			X					
	161	Identify point picture tube circuit signal becomes abnormal	X			X					
	162	Measure and interpret meaning of static voltage	X		X						
	163	Identify faulty component(s) indicated by readings	X			X					
	164	Identify function components sync separator stage	X			X					
	165	Identify point sync separator signal becomes abnormal	X			X					
	166	Measure/interpret meaning static voltages	X				X				
	167	Identify faulty component(s) indicated by readings	X				X				
	168	Identify function of components in AGC circuit	X			X					
	169	Identify point AGC circuit signal becomes abnormal	X			X					
	170	Measure/interpret meaning static voltages	X				X				
	171	Identify faulty component(s) indicated by readings	X				X				
	172	Identify function component(s) vertical output amplifier	X			X					
	173	Identify point vertical output amplifier signal is abnormal	X			X					
	174	Measure/interpret meaning static voltages	X				X				
	175	Identify faulty component(s) indicated by readings	X				X				
	176	Identify function components vertical sweep oscillator	X			X					
	177	Identify point vertical oscillator signal becomes abnormal	X			X					
	178	Measure interpret meaning static voltages	X				X				
	179	Identify faulty component(s) indicated by readings	X				X				
	180	Identify function of component(s) in horizontal oscillator	X			X					
	181	Determine point horizontal oscillator signal becomes abnormal	X			X					
	182	Measure/interpret meaning static voltages	X				X				
	183	Identify faulty component(s) indicated by readings	X				X				
	184	Identify function component(s) horizontal AFC circuit	X			X					
	185	Determine point horizontal AFC signal is abnormal	X			X					
	186	Measure interpret meaning static voltages	X			X					
	187	Identify faulty component(s) indicated by readings	X			X					
	188	Identify function component horizontal sweep output amplifier	X			X					
	189	Identify point horizontal output signal becomes abnormal	X			X					
	190	Measure/interpret meaning static voltages	X			X					
	191	Identify faulty component(s) indicated by readings	X			X					

TASK INVENTORY

TV Service and Repair
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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	192	Identify function components of high voltage supply curcuit	X			X					
	193	Identify point high voltage supply signal is abnormal	X			X					
	194	Measure/interpret meaning static voltages	X			X					
	195	Identify faulty component(s) indicated by readings	X			X					
	196	Identify function components sound IF amplifier	X			X					
	197	Identify point sound IF amplifier is abnormal	X			X					
	198	Measure/interpret meaning static voltages	X			X					
	199	Identify faulty component(s) indicated by readings	X			X					
	200	Identify function of components in sound detector	X			X					
	201	Identify point sound detector signal is abnormal	X			X					
	202	Measure/interpret static voltages sound detector	X			X					
	203	Identify faulty component indicated by readings	X			X					
	204	Identify function components audio amplifier	X			X					
	205	Determine point audio amplifier signal is abnormal	X			X					
	206	Measure/interpret meaning static voltages	X			X					
	207	Identify faulty component(s) indicated by readings	X			X					
	208	Identify function components color phase detector	X			X					
	209	Identify point color detector signal becomes abnormal		X		X					
	210	Measure/interpret meaning static voltages		X		X					
	211	Identify faulty component(s) indicated by readings		X		X					
	212	Identify function components color sub-carrier oscillator	X			X					
	213	Identify point sub-carrier oscillator signal is abnormal		X		X					
	214	Measure/interpret meaning static voltages		X		X					
	215	Identify faulty component(s) indicated by readings		X		X					
	216	Identify function components color killer circuit	X			X					
	217	Identify point color killer signal is abnormal		X		X					
	218	Measure/interpret meaning static voltages		X		X					
	219	Identify faulty component(s) indicated by readings		X		X					
	220	Identify function of components in burst amplifier	X			X					
	221	Identify point burst amplifier signal is abnormal		X		X					
	222	Measure/interpret meaning static voltages		X		X					
	223	Identify faulty component(s) indicated by readings		X		X					
	224	Identify function components bandpass amplifier	X			X					
	225	Identify point bandpass amplifier signal is abnormal		X		X					
	226	Measure/interpret meaning static voltages		X		X					
	227	Identify faulty component(s) by readings		X		X					
	228	Identify function components color demodulator	X			X					
	229	Identify point color demodulator signal is abnormal		X		X					
	230	Measure/interpret meaning stage voltages		X		X					

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	231	Identify faulty component(s) indicated by readings		X		X					
	232	Identify function components convergence circuit	X			X					
	233	Identify point convergence circuit signal is abnormal		X		X					
	234	Measure/interpret meaning stage voltages		X		X					
	235	Identify faulty component(s) indicated by readings		X		X					
	236	Relate physical resistor to schematic	X				X				
	237	Identify coded resistor parameters	X				X				
	238	Test resistor value (in circuit)	X				X				
	239	Test resistor value (out of circuit)	X				X				
	240	Evaluate result of resistance measurement	X				X				
	241	Identify physical signs resistor deterioration	X				X				
	242	Evaluate effect of electrical characteristics in circuit	X				X				
	243	Relate physical capacitor to schematic	X				X				
	244	Identify coded capacitor parameters	X				X				
	245	Quick check capacitor in circuit with ohmmeter	X				X				
	246	Test capacitor out of circuit with capacitor tester	X				X				
	247	Evaluate results of capacitor quality tests	X				X				
	248	Evaluate effect of electrical characteristics of capacitor on circuit	X				X				
	249	Identify physical signs of capacitor deterioration	X				X				
	250	Relate physical inductor to schematic	X			X					
	251	Identify coded inductor parameters	X			X					
	252	Quick check inductor in circuit with ohmmeter	X			X					
	253	Evaluate results of inductance checks	X			X					
	254	Evaluate effects of electrical characteristics on circuit	X			X					
	255	Identify physical signs inductor deterioration	X			X					
	256	Relate transformer to schematic	X			X					
	257	Identify transformer parameters from schematic catalog	X			X					
	258	Quick check transformer with ohmmeter	X			X					
	259	Evaluate results of transformer tests	X			X					
	260	Evaulate effects of electrical characteristics on circuit	X			X					
	261	Identify physical signs of transformer deterioration	X			X					
	262	Relate tube to schematic	X				X				
	263	Identify tube parameters from manual or schematic	X				X				
	264	Test tube by substitution	X				X				
	265	Test tube in tube tester	X				X				
	266	Evaluate results of tube tests	X				X				
	267	Evaluate effects of electrical characteristics on circuit	X				X				

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	268	Identify physical signs of tube deterioration	x				x				
	269	Relate specific swith or switch section to schematic	x			x					
	270	Check switch with ohmmeter	x			x					
	271	Evaluate switch tests	x			x					
	272	Identify physical signs switch deterioration	x			x					
	273	Relate circuit protector to schematic	x			x					
	274	Identify circuit protector parameters from schematic	x			x					
	275	Test tubes or circuit breaker with ohmmeter	x			x					
	276	Evaluate results of circuit protector tests	x			x					
	277	Identify physical signs circuit protector deterioration	x			x					
	278	Test continuity of wiring or circuit boards	x			x					
	279	Identify signs of physical deterioration of wiring or circuit board	x			x					
	280	Relate transistor to schematic	x				x				
	281	Identify semi conductor device parameters from schematic	x				x				
	282	Identify semi conductor device in circuit with ohmmeter	x				x				
	283	Check semi conductor device with in-circuit tester		x			x				
	284	Test simi conductor device out of circuit	x			x					
	285	Evaluate results of semi conductor device tests	x				x				
	286	Evaluate effects on electrical characteristics on circuit	x				x				
	287	Identify physical signs semi conductor device deterioration	x				x				
	288	Test flyback transformer within circuit tester		x	x						
	289	Test deflection yokes within circuit tester		x	x						
	290	Test speaker	x				x				
	291	Unsolder component from circuit board	x				x				
	292	Unfasten component physically from circuit board	x				x				
	293	Unsolder component from hand wired circuit	x			x					
	294	Unfasten component physically from wired circuit	x			x					
	295	Use model and part number to select factor replacement part	x				x				
	296	Use cross reference to select universal replacement part	x			x					
	297	Mechanically install replacement part on circuit board	x				x				
	298	Solder in replacement part on circuit board	x				x				
	299	Mechanically install replacement part on hand wired circuit	x			x					

TASK INVENTORY

TV Service and Repair
Job Title

Bob Lehman
Analyst

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			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On-the-Job Training	Related Training
	300	Solder in replacement part in hand wired circuit	X			X					
	301	Repair breaks or flaws on printed circuit board	X			X					
	302	Repair or replace defective wiring	X			X					
	303	Make post repair test of set	X				X				
	304	Clean controls (variable resistors)	X			X					

TASK INVENTORY

Radio Repairman
Job Title

Roy Milner
Analyst

INSTRUCTIONS:

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1	0	Performs Office Tasks									
	1	Price out service charges on order	X				X				
	2	Price out materials charges on order	X				X				
	3	Compute repair time	X				X				
	4	Write understandable report of work done	X			X					
	5	Make out warranty forms	X				X				
	6	Schedule service calls by priority	X				X				
	7	Schedule service calls by geography of area	X				X				
	8	Inform customer of charge	X				X				
	9	Question customer without offending	X				X				
	10	Take customer order for service	X				X				
	11	Identify warranty status of parts or labor		X			X				
	12	Use parts catalog to order replacement part	X				X				
	13	Fill out workorder correctly	X				X				
	14	Be sensitive to customer response	X				X				
	15	Use correct spelling	X				X				
	16	Use legible handwriting	X				X				
	17	Use personal hygiene	X				X				
	18	Add columns of numbers	X				X				
	19	Figure percentages	X				X				
	20	Subtract discounts	X				X				
	21	Make change correctly	X				X				
	22	Explain work done in lay terms	X				X				
2	0	Repairs and Delivers Set									
	1	Drives delivery truck	X				X				
	2	Operate moving dollies	X			X					
	3	Locate delivery address	X				X				
	4	Remove and drive screws	X				X				
	5	Remove and tighten bolts	X				X				
	6	Connect/disconnect electrical jacks and plugs	X				X				
	7	Dress or position wiring	X				X				
	8	Use wiring diagram to make electrical connections	X				X				
	9	Use assembly and disassembly instructions	X				X				
	10	Relate sound defect to customer control misadjustment	X				X				
	11	Correct sound defect by adjusting control	X				X				
	12	Instruct customer on correct use of controls	X			X					
	13	Select mechanical fasteners to install FM antenna	X		X						
	14	Select location on the building to install the FM antenna	X		X						
	15	Make mechanical connection to wood, metal or masonry	X		X						

TASK INVENTORY

Radio Repairman
Job Title

Roy Milner
Analyst

INSTRUCTIONS:

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	16	Select appropriate point of entry for transmission line		X	X						
	17	Make weatherproof transmission line entrance	X		X						
	18	Select appropriate type of transmission line		X	X						
	19	Select appropriate type of antenna		X	X						
	20	Run transmission line in the attic	X		X						
	21	Run transmission line in walls of building, rough-in state		X	X						
	22	Fish transmission line in finished walls		X	X						
	23	Install transmission line in terminal boxes		X	X						
	24	Install imped-match devices on transmission line	X		X						
	25	Use customer control to isolate trouble to FM section	X			X					
	26	Use customer control to isolate trouble to AM section	X			X					
	27	Use customer control to isolate trouble with audio section	X			X					
	28	Use customer control to isolate trouble with record changer	X			X					
	29	Identify sound symptoms indicated by preamplifier problems	X		X						
	30	Remove radio chassis from cabinet	X		X						
	31	Re-install radio chassis in cabinet	X		X						
	32	Connect signal generator to input of RF amplifier	X		X						
	33	Connect signal generator to output of RF amplifier	X		X						
	34	Identify problem requiring circuit diagnosis amplifier	X		X						
	35	Identify sound symptoms indicated by convert or mixer problems	X		X						
	36	Connect signal generator/oscilloscope to input convert stage	X		X						
	37	Connect signal gererator/oscilloscope to output convert stage	X		X						
	38	Identify problem requiring circuit diagnosis converter	X		X						
	39	Identify sound symptoms indicated by IF amplifier problems	X		X						
	40	Connect signal generator or oscilloscope to input IF amplifier	X		X						
	49	Connect signal generator or oscilloscope to output IF amplifier	X		X						
	50	Identify problem requiring circuit diagnosis of IF amplifier	X		X						
	51	Identify sound symptoms indicated by AGC trouble	X		X						
	52	Connect voltmeter to AGC bus	X		X						

TASK INVENTORY

Radio Repairman
Job Title

Roy Milner
Analyst

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	53	Identify problem requiring circuit diagnosis AGC circuit	X		X						
	54	Identify sound symptoms indicated by AM detector trouble	X		X						
	55	Connect signal generator or oscilloscope to input AM detector	X		X						
	56	Connect signal generator or oscilloscope output to AM detector	X		X						
	56	Identify problem requiring circuit diagnosis AM detector	X		X						
	57	Identify sound symptoms indicated by preamp (voltage amplifier) problem	X		X						
	58	Connect signal generator or oscilloscope to input preamp	X		X						
	59	Connect signal generator or oscilloscope to output preamp	X		X						
	60	Identify problem requiring circuit diagram preamp	X		X						
	61	Identify sound symptoms indicated by audio drive amplifier problem	X		X						
	62	Connect signal generator or oscilloscope to input audio driver	X		X						
	63	Connect signal generator or oscilloscope output audio driver	X		X						
	64	Identify problem requiring circuit diagnosis driver stage	X		X						
	65	Identify sound symptoms indicated by audio output problem	X		X						
	66	Connect signal generator or oscilloscope input and output	X		X						
	67	Connect signal generator or oscilloscope to output and input	X		X						
	68	Identify problem requiring circuit diagnosis audio output	X		X						
	69	Identify sound symptoms indicated by speaker system problem	X		X						
	70	Connect oscilloscope to input of speaker system	X		X						
	71	Identify problem requiring circuit diagnosis speaker system	X		X						
	72	Identify sound symptoms indicated by possible FM tuner problem	X		X						
	73	Connect signal generator input FM tuner stages	X		X						
	74	Connect signal generator to output of FM tuner	X		X						

TASK INVENTORY

Radio Repairman
Job Title

Roy Milner
Analyst

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	75	Identify problem requiring FM tuner replacement	x		x						
	76	Remove defective FM tuner	x		x						
	77	Re-install exchange FM tuner	x		x						
	78	Identify sound symptom indicated by FM IF amplifier problem	x		x						
	79	Connect signal generator or oscilloscope to input FM IF amplifier	x		x						
	80	Connect signal generator or oscilloscope to output FM IF amplifier	x		x						
	81	Identify problem requiring circuit deagnosis FM IF amplifier	x		x						
	82	Identify sound symptom indicated by FM detector problem	x		x						
	83	Connect signal generator or oscilloscope to input FM detector	x		x						
	84	Connect signal gererator or oscilloscope to output FM detector	x		x						
	85	Identify problem requiring circuit diagnosis FM detector	x			x					
	86	Identify sound symptom indicated by stereo demodulator problem	x			x					
	87	Connect stereo multiplex generator	x			x					
	88	Identify problem requiring circuit diagnsis stereo demodulator	x			x					
	89	Select generator suitable for AM radio IF alignment	x			x					
	90	Use output indicator (meter scope) AM IF alignment	x			x					
	91	Align AM IF amplifier to manufacturer's specifications	x			x					
	92	Select generator suitable AM RF and oscillator alignment	x			x					
	93	Use output indicated by AM RF amplifier and oscillator alignment	x			x					
	94	Align AM RF amplifier and oscillator to manufacturer's specifications	x			x					
	95	Select generator suitable for FM detector alignment	x			x					
	96	Connect generator for FM detector alignment	x			x					
	97	Connect oscilloscope to observe output of FM detector	x			x					
	98	Align FM detector to manufacturer's specifications	x			x					
	99	Select and connect generator FM IF amplifier alignment	x			x					
	100	Connect oscilloscope to observe output FM IF amplifier	x			x					
	101	Align FM IF amplifier to manufacturer's specifications	x			x					

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	102	Select and connect generator FM tuner alignment	x			x					
	103	Use oscilloscope to observe tuner output waveforms	x			x					
	104	Align FM tuner to manufacturer's specifications	x			x					
	105	Identify function of components of AM IF amplifier	x		x						
	106	Identify point IF amplifier signal is abnormal	x		x						
	107	Measure static voltage in IF amplifier	x		x						
	108	Identify possible faulty component(s)	x		x						
	109	Identify function of components in AM detector	x		x						
	110	Identify point AM detector signal is abnormal	x		x						
	111	Measure static voltage in AM detector	x		x						
	112	Identify possible faulty component(s)	x		x						
	113	Identify the function of components in AVC circuit	x		x						
	114	Identify point where AVC signal is abnormal	x		x						
	115	Measure static voltages in AVC circuit	x		x						
	116	Identify possible faulty component(s)	x		x						
	117	Identify the function of components of audio preamp	x		x						
	118	Identify point where preamp signal is abnormal	x		x						
	119	Measure static voltage in preamp	x		x						
	120	Identify possible faulty component(s)	x		x						
	121	Identify function of components of audio driver amplifier	x		x						
	122	Identify point where audio drive signal is abnormal	x		x						
	123	Measure static voltages driver amplifier	x		x						
	124	Identify possible faulty component(s)	x		x						
	125	Identify function of components of audio output amplifier	x		x						
	126	Identify point where audio output signal is abnormal	x		x						
	127	Measure static voltages of audio output	x		x						
	128	Identify possible faulty components(s)	x		x						
	129	Identify function of components in FM IF amplifier	x		x						
	130	Identify point where FM IF amplifier signal is abnormal	x		x						
	131	Measure static voltage of FM IF amplifier	x		x						
	132	Identify possible faulty component(s)	x		x						
	133	Identify function of components in FM detector	x		x						
	134	Identify point where FM detector signal is abnormal	x		x						
	135	Measure static voltage in FM detector	x		x						
	136	Identify possible faulty component(s)	x		x						
	137	Identify function of components in stereo demodulator	x		x						
	138	Identify point where stereo demodulator is abnormal	x		x						
	139	Measure static voltage in stereo demodulator	x		x						
	140	Identify possible faulty component(s)	x		x						

TASK INVENTORY

Radio Repairmen
Job Title

Roy Milner
Analyst

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	141	Identify function of components in power supply	X		X						
	142	Identify point where power supply voltage is abnormal	X		X						
	143	Interpret static voltage in power supply	X		X						
	144	Identify possible faulty component(s)	X		X						
	145	Identify function of components tone control circuit	X		X						
	146	Identify point where tone control network signal is abnormal	X		X						
	147	Identify possible faulty component(s)	X		X						
	148	Relate physical resistor to schematic	X				X				
	149	Identify coded resistor parameters	X				X				
	150	Test resistor value (in circuit)	X				X				
	151	Test resistor value (out of circuit)	X				X				
	152	Evaluate resistance measurement	X				X				
	153	Identify physical signs of resistor deterioration	X				X				
	154	Evaluate effects of electrical characteristics in circuit	X				X				
	155	Relate physical capacitor to schematic	X				X				
	156	Identify coded capacitor parameters	X				X				
	157	Check capacitor in circuit with ohmmeter	X				X				
	158	Test capacitor out of circuit	X				X				
	159	Evaluate results of capacitor quality tests	X				X				
	160	Evaluate effect of electrical charge of capacitor on circuit	X				X				
	161	Identify physical signs of capacitor deterioration	X				X				
	162	Relate physical inductor to schematic	X			X					
	163	Identify coded inductor parameters	X			X					
	164	Check inductor in circuit with ohmmeter	X			X					
	165	Evaluate results of inductance checks	X			X					
	166	Evaluate effect of electrical characteristics on circuit	X			X					
	167	Identify physical signs of inductor deterioration	X			X					
	168	Relate transformer to schematic	X			X					
	169	Identify transformer parameters from schematic	X			X					
	170	Check transformer with ohmmeter and/or voltmeter	X			X					
	171	Evaluate results of transformer tests	X			X					
	172	Evaluate effects of electrical characteristics on circuit	X			X					
	173	Identify physical signs of transformer deterioration	X			X					
	174	Relate tube to schematic	X				X				
	175	Identify tube parameters from manual	X				X				
	176	Test tube by substitution	X				X				
	177	Test tube in tube tester	X				X				

TASK INVENTORY

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	178	Evaluate results of tube tests	X				X				
	179	Evaluate effects of electrical characteristics on circuit	X				X				
	180	Identify physical signs of tube deterioration	X				X				
	181	Relate switch or switch section to schematic	X			X					
	182	Check switch with ohmmeter	X			X					
	183	Evaluate switch tests	X			X					
	184	Identify physical signs of switch deterioration	X			X					
	185	Relate circuit protector to schematic	X			X					
	186	Identify circuit protector parameters	X			X					
	187	Test fuses or circuit breaker	X			X					
	188	Evaluate results of circuit protector tests	X			X					
	189	Identify physical signs of circuit protector deterioration	X			X					
	190	Test continuity of wiring or circuit boards	X			X					
	191	Identify signs of physical deterioration of wiring on circuit boards	X			X					
	192	Relate transistor to schematic	X				X				
	193	Identify semi conductor device parameters	X				X				
	194	Check semi conductor device in circuit	X				X				
	195	Check semi conductor device with in-circuit tester		X			X				
	196	Test semi conductor device out of circuit	X			X					
	197	Evaluate results of semi conductor device tests	X				X				
	198	Evaluate effects on electrical characteristics on circuit	X				X				
	199	Identify physical signs of semi conductor device deterioration	X				X				
	200	Test speaker for electrical defects	X		X						
	201	Test speaker for mechanical defects	X		X						
	202	Unsolder component from circuit board	X				X				
	203	Unfasten component physically from circuit board	X				X				
	204	Unsolder component from wired circuit	X			X					
	205	Unfasten component physically from wired circuit	X			X					
	206	Use model part number to select replacement part	X				X				
	207	Use cross reference to select universal replacement part	X			X					
	208	Mechanically install replacement part on circuit board	X				X				
	209	Solder replacement part on circuit board	X				X				
	210	Mechanically install replacement part wired circuit	X			X					
	211	Solder replacement part in hand wired circuit	X			X					
	212	Repair breaks or flaws on printed circuit board	X			X					
	213	Repair or replace defective wiring	X			X					

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	214	Make post repair test of set	X				X				
	215	Adjust drag tension of feed reel		X	X						
	216	Adjust tension of take-up reel		X	X						
	217	Adjust tape guides		X	X						
	218	Adjust pressure pad		X	X						
	219	Align record and erase heads		X	X						
	220	Ajust for smooth braking action		X	X						
	221	Check tape speed with strobescope	X		X						
	222	Check tape output for wow and flutter	X		X						
	223	Identify sound or visual symptom indicated by mechanical problem	X		X						
	224	Identify sound symptom indicated by electrical trouble	X		X						
	225	Identify symptom of problem of peculiar record function	X		X						
	226	Identify symptom of problem of peculiar play back function	X		X						
	227	Identify slipping drive belts/friction pulley	X		X						
	228	Identify points of mechanical binding	X		X						
	229	Clean and demagnatize record and erase heads		X	X						
	230	Disassemble complex mechanical equipment	X		X						
	231	Follow mechanical train of action	X		X						
	232	Identify point of failure in mechanical train		X	X						
	233	Identify broken or worn mechanical parts	X		X						
	234	Select proper lubricating points and lubricate		X	X						
	235	Test fractional HP of electric motors	X		X						
	236	Repair or replace electric motors indicated		X	X						
	237	Replace drive belts and pulleys		X	X						
	238	Identify defective record or erase head		X	X						
	239	Replace and align record or erase head		X	X						
	240	Identify sound symptoms indicated by erase/bias oscillator trouble	X		X						
	241	Measure/erase oscillator output	X		X						
	242	Identify operating characteristics of erase oscillator	X		X						
	243	Measure and interpret erase oscillator static voltage	X		X						
	244	Identify possible faulty component(s) indicated	X		X						
	245	Identify sound symptoms indicated by electrical trouble	X		X						
	246	Identify sound or visual symptoms indicated by mechanical problem	X		X						
	247	Adjust head pressure		X	X						
	248	Adjust correct stylus indexing point		X	X						
	249	Adjust for correct stylus record clearance		X	X						

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	250	Identify defective stylus by sound or visual symptoms	x		x						
	251	Identify defective stylus with microscope	x		x						
	252	Check turntable speed with strobescope	x		x						
	253	Identify slipping drive belts or friction pull	x		x						
	254	Idenfity points of mechanical binding	x		x						
	255	Assemble and disassemble mechanical equipment		x	x						
	256	Follow mechanical train of action	x		x						
	257	Identify failure of mechanical train of action		x	x						
	258	Identify broken or worn mechanical parts		x	x						
	259	Select proper lubricating points and lubricate		x	x						
	260	Test fractional HP motors		x	x						
	261	Repair or replace drive motor as indicated		x	x						
	262	Clean or replace drive pulleys and belts	x		x						